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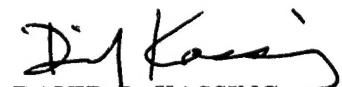
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FOREWORD

This is an index of all publicly available papers by staff members of the Center for Naval Analyses, either issued as CNA publications or published outside in the professional literature. Our purpose in issuing this index is to increase the usefulness of these contributions to the scientific and scholarly community.

This index, fourth in the series of Selected Publications Indexes, is brought up to date periodically. Recipients are on a permanent distribution list and will be sent new editions as they are issued.

DAVID B. KASSING
President
Center for Naval Analyses

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I. INTRODUCTION

This publication updates and supersedes the issue dated March 1974. It has been prepared to make readily available the titles and abstracts of unrestricted publications by the Center for Naval Analyses. It includes formal publications issued by the Center, books authored or co-authored by CNA employees and presentations and articles published in the open literature.

DESCRIPTION OF THE CENTER FOR NAVAL ANALYSES

CNA is a private, non-profit, research organization operated on behalf of the Navy Department by the University of Rochester. The type of research conducted for the Navy falls into two broad categories:

(1) The operations research activities cover a broad range of naval activities including antisubmarine warfare, air warfare, submarine warfare, fleet air defense, naval communications, and tactical development and evaluation. Emphasis is placed on exercise design, reconstruction, and analyses; and in helping fleet commanders by developing new tactics and providing reliable data for planning operations.

(2) Warfare technical and support studies deal with the relationship between technology and system performance; and problems of choice concerning the use of scarce resources, be they weapons, equipment, people, budgets, or the like. These studies are undertaken to provide decision-makers with meaningful analytical information that is relevant to a particular set of issues and alternatives.

The Center was formed in July 1962 to bring together under single management several research groups that were conducting operations research and systems analysis studies for the Navy. Consolidation of research activities under a single management provides a degree of flexibility and comprehensiveness that otherwise could not be easily achieved.

CNA is the direct descendant of the Antisubmarine Warfare Operations Research Group (ASWORG), organized in 1942 as the first formal operations research organization in this country. ASWORG's first problem was to help defeat the U-boat, and its solutions have become classic examples of O.R. techniques applied to a naval problem. At the close of the war Fleet Admiral King and Secretary Forrestal concluded that much of the unique value of the organization was its ability to provide an independent, unbiased, and scientific viewpoint. The wartime arrangement was continued by means of a contract with M.I.T. The value of placing scientific analysts at sea and at command headquarters to develop immediate and practical answers to tactical and planning questions was proven during the war, and has been continued through an on-going field program involving approximately 20 percent of the CNA staff.

CNA's research is carried out by five research groups that are organized and staffed to bring inter-disciplinary expertise to bear on specific problem areas.

The Operations Evaluation Group, the oldest military operations research group in the United States, is concerned with tactical analyses for immediate or near-future use by the Office of the Chief of Naval Operations and the operational and test commands. Its program consists of assistance in the design and analysis of fleet exercises, evaluation of new equipment, operations, the development of tactical doctrine to improve operational effectiveness, and the assignment of representatives to 17 naval commands.

Institute of Naval Studies. The studies of the Institute fall into four categories: (1) studies relating political and economic conditions or influences to naval strategy, (2) supply, logistics, and naval industrial facilities, (3) manpower and personnel, and (4) resource allocation and cost. These elements—strategy, logistics, resources—cut across the major missions of the Navy.

The Marine Corps Operations Analysis Group supports the Marine Corps through operations analysis and studies the cost and effectiveness of alternative force structures, ground and aviation weapon systems, and logistic systems; analysis and evaluation of amphibious assault concepts and operations; design and evaluation of tests of new organizations, new equipment, doctrine, and operations. CNA representatives from MCOAG are assigned to Fleet Marine Forces, Atlantic and Pacific, and the Marine Corps Development and Education Center (MCDEC). Additional support is provided MCDEC by the staff in Washington. All research and study efforts are coordinated with staff officers at Headquarters, Marine Corps. Operational test and evaluation support is integrated with the capability available to MCDEC.

The Naval Warfare Analysis Group conducts cost-effectiveness and technical analyses that focus on Navy procurement and program decisions in antisubmarine, undersea, and strategic warfare. Some of these analyses draw heavily on the physical sciences and engineering; others are concerned with the resource allocation effects of development and procurement programs. In the main, NAVWAG studies force level and force mix problems to help the Navy understand better the implications of competing demands on its resources. The NAVWAG program also includes studies that deal with broad strategy problems, relating mainly to the Strategic Arms Limitation Talks and various alternative NATO strategies.

The Systems Evaluation Group conducts system and technical analyses in tactical air warfare, fleet air defense, surface warfare, and communications. The system analyses deal with the size, mix, and utilization of future forces and with the costs of buying and operating them In the technical analysis effort, emphasis is placed on analyzing the relations among technical characteristics, costs, and performance; determining the feasibility of new system proposals; forecasting the technological capabilities of the United States and potential adversaries; and studying the interactions between systems and the environment in which they are employed.

In addition to these five operating groups, CNA has a *Public Research Institute,* which conducts studies for government agencies concerned with non-defense problems.

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> This type of publication is not now issued by CNA. They were reports on a large analytical effort requiring many man-weeks and normally received a wide distribution; they are now issued as studies.
>
> *Studies. (CNS, INS, NWS, OES, SES, PRI)*
> These are the publication forms normally used for the results of Research Projects requiring more than a few man-weeks of analytical effort. Studies are usually complete, self-substantiating analyses that provide a basis for executive decision, or for recommendation to higher authority. Studies are originated by any one of the various operating groups within CNA and the Public Research Institute. PRI also issues Reports on continuing research. They represent the best opinion of CNA at the time of issue.

Interim Research Memoranda. (NIRM, OIRM)
These publications are now issued as Research Contributions.

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A relatively new type of publication; they are scientific and technical reports, articles for professional journals, lectures, speeches and similar material not appropriate for publication as a CNA Study or Research Contribution.

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defense, resource allocation PP 76, 110; NRC 40; P 1041; M 1013, 1014, 1021
input-output model and analysis CRC 134; P 1019, 1031
non-linear game solution CRC 23
ocean resources PP 7, 28, 49; A 1012; P 1028
stochastic optimization PP 21
with application to Naval resupply system PP 47

Surveillance
    anti-vehicular and anti-personnel, surveillance system, raid recognition capabilities PP 102
    ocean, tracking effectiveness, stochastic model OIRM 41
    satellite surveillance, effectiveness model IRC 5
    undersea surveillance system, cost considerations ORC 83

Transportation P 1039
    air
        congestion CRC 154
        congestion math model CRC 169
        demand CRC 162
        demand forecast, 1980 CRC 163
        value of time CRC 162

Naval and Marine Corps flight activity CRC 160; INS 34
Soviet domestic transportation A 1067

Vision Research
    airborne visual search for snorkeling submarines, value of binoculars OES 624
    air-sea rescue vision OES 250
    detection and scaling of statistical differences between visual textures A 1045
    target detection, daylight vision A 1018
    visual detection of aircraft probability OES 368, 430, 470

SECTION III

A. CENTER FOR NAVAL ANALYSES

● **Studies**

CNS 1023

Devine, Eugene J. and Forst, Brian E., "Navy Physician Staffing Levels," 102 pp., Oct 1973, AD 921 453L

For the past 30 years the Navy has been able to procure physicians at greatly depressed salaries because of conscription, and this has been reflected in staffing levels. Efficient adjustment to the new all-volunteer environment will entail the provision of medical care with fewer physicians (and more of various other inputs). However, there exists no widely accepted method of determining physician staffing in either the military or civilian sectors. The method we have chosen is to compare Navy physician staffing with that of the Kaiser Plan. One important difference between the two systems which makes the comparison especially relevant is that the Kaiser Plan has had to pay market prices for all its resources, as will the Navy in the future, and staffing patterns reflect this. There are also other important differences between the two systems. Our analysis consists of making adjustments for these differences.

CNS 1025

Harrington, James R., LaVallee, William (Cdr., USN), Lloyd, Richmond M., and Spruill, Nancy L., "Aircraft Periodic Depot Level Maintenance Study," 105 pp., Nov 74, AD B002 570L

This study examines the Navy periodic depot maintenance program for aircraft. It includes evidence that Navy aircraft are inducted for periodic depot level maintenance (PDLM) too often and that too many maintenance man-hours are expended when they are given PDLM. The rework man-hours being expended at depot are not directly related to operational factors but rather to the fact that maintenance managers have strong incentives to err on the side of safety by doing more maintenance and doing it more often than is needed. An alternative PDLM program based on decision logic and reliability is offered which corrects this situation and allows a continuous appraisal.

CNS 1030

Devine, Eugene J., "Procurement and Retention of Navy Physicians," 157 pp., Oct 1973, AD 921 267L

How can the Navy best attain authorized physician staffing levels now that conscription has

ended? To answer this question, medical scholarship pay, proposed variable incentive pay, and present continuation pay are evaluated from the standpoint of financial attractiveness to the physician and the rate of return on the Navy's investment. Lifetime earnings under the current and proposed compensation plans are compared with those of civilian physicians. Conclusions are drawn about both the short and the long range aspects for an adequately staffed all-volunteer Medical Corps.

CNS 1039

Carroll, Hugh E. (LCdr., USN), Hunter, Dwight L. (USN), Lockman, Robert F., May, Robert E. (Capt., USN), McKinley, Harold H. (LCdr., USN) Stoloff, Peter H., and Wojdylak, Marcella, "Enlisted Selection Strategies," 119 pp., Sep 1974, AD A014 576

The efficiency and fairness of procedures used to select enlisted men for the Navy and for schools, jobs, and advancement are examined. The literature on selection-testing, training, and performance evaluation is reviewed. Ways of increasing personal performance and opportunity are suggested.

CNS 1048

Bender, Susan E., Hale, Robert F., Jondrow, Anne S., Koehr, James E. (LCdr., USN), Kuzmack, Richard A., "The Capital Structure for Ocean Science: Final Report of the Ocean Science and Technology Resources Study (ORS)," 81 pp., Mar 1975, AD A021 217

The Ocean Science and Technology Resources Study (ORS) determines whether there is underinvestment in the capital assets needed for future United States efforts in ocean science and estimates costs to meet any underinvestment. ORS also determines whether existing capital assets are underutilized. Assets considered in ORS include ships, aircraft, submersibles/habitats, and major computers; ORS concentrates on ships since they are by far the most numerous type of assets.

CNS 1050

Carroll, Hugh E. (LCdr., USN), Forst, Brian E., Jehn, Christopher, Kleinman, Samuel D., Rudwick, Nancy, Shughart, William F. (USN), Wojdylak, Marcella, "The Use of Reenlistment Bonuses," 72 pp., 9 May 1975, AD B008 573L

Reenlistment bonuses are a powerful tool for affecting the retention behavior of enlisted

CNS 1050 – Continued

personnel. The proper allocation of these bonuses across ratings was found to require information the Navy does not currently possess. A technique was developed for assisting in this allocation process when the ideal information is not available. Recommendations are made for altering or improving the criteria on which bonus allocations are based. The Navy's personnel data system and future research needs are also evaluated.

CNS 1052

Bender, Susan E., Hale, Robert F., Jondrow, Anne S., Koehr, James E. (LCdr., USN), Kuzmack, Richard A., "The Capital Structure Supporting Atmospheric Research," 57 pp., Jan 1975, AD A022 965

This report describes a study of the capital structure supporting Federal atmospheric research. A base of inventory and utilization data for computers, aircraft, and radars was developed through a survey and the future availability of the capital services from these assets was projected. In addition to the services from Federally-operated assets, the projections include those from other sources such as universities and contractor-operated laboratories. The utilization data include both actual and potential full use of each asset, and these data are used to address the extent of possible underutilization of the assets. The projected services are compared with the reported requirements of Agency-approved atmospheric research programs, to provide an initial estimate of the adequacy of the planned capital inventory.

CNS 1061

Cohan, Lawrence S., Heider, Charles H., Jehn, Christopher, Mitchell, Thadeus R., and Quick, Beverly J., "Hydrofoils for the Fisheries Law Enforcement Mission of the U.S. Coast Guard," 283 pp., Jul 1975, AD A020 366

This study compares the effectiveness and costs of hydrofoil craft with those of conventional Coast Guard platforms, including cutter/helicopter teams, in the performance of the fisheries law enforcement mission. The comparisons are made for various fisheries law enforcement tasks considered independently of one another and of geographic considerations, and also in two specific geographic scenarios, in waters off New England and Alaska, where each platform is required to perform a specific set of tasks. The study also investigates the degree to which hydrofoils, engaged in a primary fisheries law enforcement role, could contribute to the search

and rescue (SAR) mission without undue detraction from their primary role.

Research Contributions

CRC 1

Isaacs, Rufus, "Differential Games, A Mathematical Theory with Applications to Warfare and Other Topics," 560 pp., 3 Dec 1963, (Also published as book, see B 4) AD 600 022

CRC 1

Linnell, Richard D., "A Subsonic Analog of the F-111A Airplane," 13 pp., Aug 1964, AD 761 188

An engineering examination is made of subsonic analog of the F-111A to determine what savings can be made in terms of weight and cost. It is concluded that so long as both planes have the same mission, both planes will have nearly the same gross takeoff weight. However, savings in cost appear to be substantial.

CRC 2

Bram, Joseph, "The Directional Derivative of $\varphi(x) = \min F(x,y)$," 8 pp., 12 Feb 1964, AD 439 025

Necessary conditions for x_0 to yield the maximum of $\varphi(x) = $ minimum of $F(x,y)$ with respect to y, subject to constraints, are presented. If $\varphi(x)$ is concave, the conditions are also sufficient. The function $\varphi(x)$ has been treated in detail by Danskin. The results given here generalized previous results of Kuhn and Tucker, and Danskin.

CRC 3

Bram, Joseph and Weingarten, Harry, "Estimation of Binomial Parameters from Search Data," 7 pp., 5 May 1964, AD 703 924

The parameters of the binomial distributions are the constant probability from trial to trial, and the number of trials. In sampling from a binomial population, the number of trials is usually known. Estimates are provided from observed data of the constant probability and of the number of trials.

CRC 6

Westlund, George A., "Weapon Pattern Effectiveness II; CNA Computer Program 32-64P," 67 pp., 3 Feb 1965, AD 473 721

An IBM 7090 computer program is described that uses a Simpson's Rule integration technique

CRC 6 – Continued

to compute the probability of destroying a rectangular or line target with at least one weapon of a salvo, stick, or pattern of weapons. Flow charts, a listing of the FORTRAN program, and a sample problem are included.

CRC 8

Bram, Joseph, "A Nonlinear Optimal Allocation Problem," 10 pp., Apr 1965, AD 758 415

An efficient computing procedure is provided for a problem arising in the optimal allocation of weapons of different types to targets of different classes. The limited numbers of weapons available are assumed to be known.

CRC 11

Smith, Robert L., "EVENT, CNA Computer Subroutine 14-65S," 13 pp., 3 May 1965, AD 469 691

The Monte Carlo simulation programs used at CNA require a routine that maintains an ordered list of future events, that is, a list that is used by the program to determine the subroutine execution sequence. The EVENT subroutine is written in FORTRAN and both stores and retrieves events from the ordered list.

CRC 12

Mason, Thomas W., "RKUTTA, CNA Computer Program 21-65S," 14 pp., 6 Jun 1966, AD 485 146

A computer program written in FORTRAN is described which allows the solution of n simultaneous, first order, ordinary differential equations by a variation of the Runga-Kutta method due to Gill. A sample Problem is solved, and flow charts and a listing of the program are included.

CRC 13

Mason, Thomas W., "SIMSON, CNA Computer Program 22-65S," 15 pp., 6 Jun 1966, AD 488 390

A FORTRAN computer program is described that performs single or multiple integration by Simpson's Rule. A development of the quadrature formula is given and sample problems are shown. Flow charts and a listing of the program are included.

CRC 14

Mason, Thomas W., "DATA Subroutine: CNA Computer Program 13-65S," 17 pp., 26 Aug 1965, AD 758 416

A computer program written in FORTRAN is described which allows the facility of free-format

data input. Flow charts and a listing of the program are included.

CRC 15

Broussalian, Vartkes L., "The Evaluation of Non-Marketable Investments," 32 pp., 30 Jun 1965, (Superseded by SRC 9) AD 622 269

CRC 16

Kitchens, Jacqueline, "A Computer Method of Analysis of Amphibious Ship-to-Shore Movements: CNA Computer Program 15-65P," 43 pp., 6 Dec 1965, AD 758 417

This paper describes a computer method of preparing certain build-up curves associated with the analysis of the operations of amphibious ship-to-shore movements.

CRC 17

Liguori, Robert R., "Monte Carlo Convoy Attack Probability Model; CNA Computer Program 22-64R," 43 pp., 10 Dec 1965, AD 831 160

An IBM 7090 computer program is described that uses a Monte Carlo simulation technique for determining torpedo hit probabilities. The problem of m hits on n ships with a delivery of a salvo of torpedoes by a submarine is found, where the ships are arranged in a rectangular array. Flow charts, a listing of the FORTRAN program, and a sample problem are included.

CRC 20

Denenberg, Stewart A., "Computer Subroutines: 4-66S (C3 CNA ERRF); 5-66S (G5 CNA RANUMB); 6-66S (G5 GRNUMB)," 14 pp., 7 Apr 1966, AD 482 437

Three statistical subroutines are described which are presently available as CDC 3400 COMPASS Subroutines. The first, 4-66S(C3 CNA ERRF), calculates the error function. The second and third, 5-66S(G5 CNA RANUMB) and 6-66S(G5 CNA GRNUMB), are used to generate uniformly distributed and Gaussian distributed pseudo-random number sequences, respectively.

CRC 21

Breckner, Norman V. and Noah, Joseph W., "Costing for System Analysis," 19 pp., 30 Mar 1966, (Revised version published in "Defense Management," edited by Stephen Enke, see B 11) AD 636 273

CRC 22

Danskin, John M., "On Suboptimization: An

CRC 22 – Continued

Example," 5 pp., 17 Jun 1966, AD 669 291

In certain allocation problems concerning groups of systems, it is possible to allocate by allocating within each system and then combining the results. This paper shows that while this method is correct for pure maximum problems and for cases in which the overall problem is a game, it is not true for Max-Min problems.

CRC 23

Danskin, John M., "Solution of a Nonlinear Allocation Game by Perturbation of the Side Conditions," 24 pp., 9 Jun 1966, AD 637 550

A nonlinear military allocation game is reduced by a device to a series of linear games, thus permitting easy solution and easy examination of the effect of perturbation of side conditions. An application to a practical problem of allocation in antisubmarine warfare is given.

CRC 24

Danskin, John M., "A Helicopter versus Submarine Search Game," 16 pp., 9 Jun 1966 (Published in "ORSA Journal," Vol. 16, No. 3, May-Jun 1968) AD 636 169

How should helicopters use their dipping sonar so as to search for a submarine, now submerged and attempting to escape, which had been sighted a short time before? The problem is brought to a simple 2-person zero-sum game in which one side juggles areas and the other probability distributions. The solutions are exhibited and proved to be solutions by direct application of the definition of optimal strategies for a game. The solution may be understood with very little mathematical knowledge.

CRC 25

Smith, Robert L., "The Determination of a Scheduling Rule for a Computing Center," 107 pp., Nov 1967, (Published as Master's Thesis, School of Engineering and Applied Science, George Washington University, Washington, D.C., Feb 1968) AD 665 687

The scheduling of computer time is a critical element in providing efficient service to computer center users. The search for a scheduling rule for the CNA Computer Center is described. A queueing model is developed to describe the work flow. An event-store Monte Carlo simulation program was written and is used to evaluate scheduling rules.

CRC 29

Liguori, Robert R., "Exterior Ballistics; CNA Computer Program 56-66S," 132 pp., Jul 1967, AD 831 158

A method for solving the differential equations of motion of the trajectory of a projectile in air is given along with a description of the computer program of the method. Tables of ballistic drag coefficients for various bombs currently in use are included. The results of polynomial regression analyses of the drag coefficient data are also given.

CRC 30

DiBona, Charles J., "Where is Systems Analysis?" 8 pp., 3 Apr 1968, (Presented at 20th Symposium, Military Operations Research Society, 12 Dec 1967) AD 686 702

A brief discussion of the present state of system analysis.

CRC 104

Schaeffer, George J., "Description of the CNA Scope Operating System," 5 pp., Oct 1968, AD 682 550

The characteristics and operational capabilities of the CNA Scope Operating System are described. Emphasis is placed on output backgrounding and the use of random-access equipment.

CRC 105

Cook, Allen P. (Capt., USN), Homan, Clifford C. (Lt., USN), Mickley, Robert E. (LCdr., USN), Pullin, Millard E. (Maj., USMC), and Young, Leonard R. (LCdr., USN), "Command and Control Roles and Staff Functions of Major Amphibious Force/Group Commanders," 95 pp., Mar 1969, AD 859 507

A general concept of large scale amphibious assault operations is described. The command and control roles of major amphibious commanders and the operational tasks common to all amphibious operations are identified. The functions of the major staffs are determined and grouped operationally into a set of vital functions which are described in detail.

CRC 106

Heselton, Jr., Leslie R., "The Continental Shelf," 40 pp., Dec 1968, AD 686 703

The characteristics and extent of the world continental margin are described. The geological differences between the continental platforms and

CRC 106 – Continued

the ocean basins are described and portrayed. The size and location of shallow water areas of less than 1000 fathoms are described in detail. A bathymetric figure is shown for each area with a significant amount of shallow water. References for more detailed investigation are appended.

CRC 108

Stotland, Victor G., "Fisher Exact Probability Test," 15 pp., Jan 1969, AD 849 853

The Fisher Exact Probability Test is defined and cases where it may be used are shown. A FORTRAN program for calculating the required values is explained.

CRC 109

Kingsley, R. A., "Amphibious Staff Functional Relationships and Activity Patterns," 59 pp., Aug 1969, AD 859 007

Tasks and staff functions of the Commander Amphibious Task Force (CATF) and Commander Landing Force (CLF) are described. Staff functional relationships are described in terms of sets and subsets of activities. A method is presented for determining the most typical activity pattern of a staff in response to external events. The method is applied to a sample of 52 hypothetical events to suggest optimal ways of staff partitioning.

CRC 110

Bram, Joseph, "Some Simple Proofs in Semi-Markov Processes," 10 pp., Feb 1969, AD 849 854

By invoking the ergodic theorem, most of the important averages of probabilistic systems that can be represented as semi-Markov systems can be obtained as limits of ratios, precisely as in the cases where the law of large numbers is applicable. The procedure is illustrated with several examples.

CRC 113

Bart, Robert and Cohan, Lawrence S., "Model of Anti-Convoy Effectiveness (MACE): A Computer Model for Anti-Shipping Wars," 28 pp., Apr 1969, AD 854 153

A computer model has been developed to aid in studying naval war scenarios in which anti-shipping operations are the main consideration. Performance of the forces involved is specified by probabilities of carrying out assigned missions, such as penetrating escort screens and attacking convoyed shipping. The model calculates

expected values of the losses suffered by these forces. The model is designed to cover a wide range of problems.

CRC 114

Athay, Robert E., "An Economic Appraisal of Soviet Merchant Shipping Policy," 141 pp., Apr 1969, AD 687 464

This analysis, which assesses the economic efficiency of the heavy commitment of resources to the Soviet Merchant Fleet in recent years, involves a comparison of the real costs incurred with the real benefits obtained. Soviet cost accounting practices and prices do not necessarily correlate with supply and demand. Therefore, the money costs of ocean shipping as reported by the Soviets are poor indicators of real costs. Since Soviet prices are even less meaningful in reflecting utility than in indicating costs, cash flows arising from merchant shipping operations could not be used as the primary measure of real benefits. The hard-currency earnings of the merchant fleet have been of particular importance, since they have been sufficient to offset a significant fraction of the deficits arising from Soviet commodity trade with the West.

CRC 118

Culbertson, Denny D., "An Application of Semi-Markov Chains to ASW Tactical System," 11 pp., 26 Sep 1969, AD 698 000

An application of semi-Markov chains to antisubmarine warfare (ASW) tactical systems is illustrated with a hypothetical example. The example involves estimating the probabilities of prosecuting false contacts for varying lengths of time. The use of Markov chains in the analysis of ASW systems, using Fleet ASW Data Analysis Program (FADAP) data, is discussed briefly.

CRC 119

Lando, Mordechai E., "Linking A Variable Weight Series," 8 pp., May 1969, AD 695 386

The problems caused by using any particular month to link a series which has variable weights are discussed. It suggests that a series of this type requires a separate linking constant for each set of weights.

CRC 120

Hall, John V. (Cdr., USN), "Distribution of Losses in an Idealized Anti-Shipping Campaign," 21 pp., 9 Jul 1969, AD 857 966

An idealized, steady-state and anti-shipping

CRC 120 – Continued

campaign carried out by submarines whose operations are mutually independent is described. The probability distribution of the number of successful patrols per submarine is derived and the probability distribution of the total shipping losses (total number of ships hit) is approximated.

CRC 129

Ozols, Juris L., "CNA Computer Program 19-69; Weapon Pattern Effectiveness III," 30 pp., Oct 1969, AD 704 107

A Monte Carlo simulation program has been written in FORTRAN to compute hit probabilities of a pattern of weapons against a maneuvering target. The aimpoint is specified, and a bivariate-normal aiming error is assumed for the weapon pattern; individual weapons in the pattern are assumed to have bivariate-normal (ballistic) dispersion errors. Target initial velocity, time spent in a straight leg, turning radius, and time spent in the turn are specified, and a normal distribution of errors is assumed for these parameters. Effects of target acceleration are included. Flow charts, program listing, and sample inputs and outputs are provided.

CRC 130

Hinich, Melvin J., "Introduction of Fourier Analysis of Data," 37 pp., Nov 1969, AD 703 670

This is an introduction to the basic elements of Fourier analysis of a time series that is a sum of deterministic components and a stationary random process. The concepts are presented in a basically intuitive manner, intended primarily for economists and data processors.

CRC 131

Lando, Mordechai E., "Measuring Productivity in the U.S. Shipbuilding Industry," 31 pp., Sep 1969, AD 712 462

This paper measures changes in productivity and real labor costs in the shipbuilding industry. Several alternate measures are presented, all of which indicate that productivity rose during 1958-1966. It is argued that the increase in productivity was due to increased demand for ships and not due to the introduction of new technology. An appendix discusses the available price indexes for the shipbuilding industry.

CRC 133

Hillerman, Neal H. and Paul, Margaret K., "The Calculation Procedure of the CNA Version of the Code 50 Nuclear Exchange Model," 408 pp., Feb 1970, AD 870 017

The CNA 50 Nuclear Exchange Model permits a 3-strike exchange between 2 opponents. The first 2 strikes may each be either counterforce, countervalue, or a combination of both, as desired. The third strike is always a countervalue strike. The assignment of weapons to targets in each strike is made in an inner calculation, using a Lagrange multiplier method. Flow charts and a listing of the associated computer program are included.

CRC 134

Augusta, Joseph H., Jenner, Richard A., and Ryhanych, G. W. (Maj., USMC), "Interim Input-Output Resource Allocation Model," 24 pp., 2 Mar 1970, AD 866 655

This model is an "input-output" model, which accounts for and allocates indirect operating costs created by the many interactions between Marine Corps units. The cost model provides 3 types of information. First, it provides direct operating cost for all Marine Corps organizations on the east coast, both Fleet Marine Forces (FMF) and non-FMF. Second, it allocates the operating costs of the support establishment (normally called indirect support costs) to the FMF units receiving the support. Third, it provides estimates of the effect of any specified change in the FMF upon the support establishments' operating costs, and estimates the needed additional resources, including manpower.

CRC 137

Hall, John V. (Cdr., USN), Tyson, James K., and Finucane, James S., "A Model of Carrier-Submarine Interactions," 33 pp., Feb 1970, AD 867 847

This paper develops analytic expressions for the probability that a single aircraft carrier, opposed by submarines, can remain on station for a specified length of time. The threat from both torpedo and cruise-missile submarines is considered. A wide variety of ASW force compositions and tactics can be represented in the parameters of the model. Appendix C presents an alternative way to formulate the problem and derive the quantities mentioned above. The two methods produce results that are in excellent agreement. The intention of the authors is to provide a tool that can be used to improve carrier effectiveness through the study of tactics and force interactions.

CRC 142

Overholt, John L., "Sensitivity Tests on SLAT Computer Simulations Using Experimental Design," 49 pp., Jun 1970, AD 716 719

This paper demonstrates that the statistical experimental design technique aids the analysis of complex simulation by efficient selection of the computer runs to be made and thereby saves computer time. Further the analysis is more complete, showing that the variables act jointly and measures the goodness of fit of predicted values. As an example, the sensitivity tests on changes in air sortie effectiveness on a land campaign are discussed. The techniques, terminology and calculation methods with a bibliography are discussed in an appendix.

CRC 144

Richardson, Robert P. and Waldron, Stephen, "An Analysis of Recent Conflicts," 305 pp., Jan 1970 (also published as INS Study 14, Annex B), AD 704 878

Three hundred eighty conflicts initiated during the years 1946-1964 are analyzed. The analysis of recent conflicts has 3 major objectives: (1) To confirm or counter assumptions about limited warfare situations in the period 1946-1964 in order to provide greater validity in predicting such situations in the future; (2) To identify the major variables involved in the various kinds of recent conflicts so that these variables will be used appropriately in the analysis of future conflicts of a similar type; and (3) To provide a data base from which important implications about the nature of recent conflicts may be derived so that effective processes of deterrence and control may be perceived for future application.

CRC 147

Palmer, Wilfred W., "A Model of Fleet Defense by Interceptor Aircraft," 25 pp., Apr 1970, AD 711 349

An iterative Monte Carlo computer simulation of fleet defense by carrier-based aircraft is described. The model is completely general in regard to the size of the committed forces and the capabilities of their weapons, and it allows some diversity in the composition of the defending interceptor force. It also permits consideration of a variety of tactical options.

CRC 149

Behrns, Vernon N., "Least Squares Fitting of Exponential Functions," 31 pp., Mar 1970, AD 706 096

In attempting to fit an exponential function to a set of data points by the method of least squares, the general situation is that the equations resulting from partial differentiation are transcendental in one or more of the parameters and cannot be solved by the usual algebraic methods. This paper develops two methods for dealing with the above difficulty.

CRC 154

Schmid, Stuart G., "General Aviation, Naval Aviation and Congestion, with an Example from Southern California," 23 pp., Jan 1971, AD 719 906

Federal Aviation Authority projections of general aviation activity for 1980 show a 75 percent increase over 1969 levels. This paper describes a simple computational model used to translate projected general aviation growth into implied densities and aircraft interaction frequencies. The model is applied to Southern California and a case study is made of Miramar NAS at San Diego.

CRC 155

O'Neill, David M., "Meeting the Navy's Needs for Technically-Trained Personnel; Alternative Procurement Strategies," 54 pp., Jul 1970, AD 715 142

This paper demonstrates 2 factors regarding the problem of choosing optimum procurement strategies for obtaining technically-trained personnel. It shows that the magnitude of the resources potentially amenable to different procurement strategies is not trivial, and that switching to some form of contracting-out system to procure some or all of its general training would have a high probability of resulting in significant reductions in costs per graduate. The product of these 2 factors are the savings in total Navy training costs that would be achieved from changing procurement strategies.

CRC 158

Bingham, Origen K., "Air-to-Ground Gunnery Simulation; CNA Computer Program 6-70 (Program AIRTOGR)," 45 pp., 30 Nov 1970, AD 718 352

This research contribution presents a computer program that employs a Monte Carlo simulation to determine the probability of destroying a rectangular target with air-to-ground gunnery. The effect of correlation of successive aim points is considered, and bivariate-normal aiming error and

CRC 158 – Continued
ballistic dispersion are assumed. A flow chart, a listing of the FORTRAN program, and a sample program are included.

CRC 160
Brumbach, Lawrence E., "A Survey of Navy and Marine Corps Flight Activity," 209 pp., 10 Mar 1971, AD 722 698
A comprehensive data base is presented with detailed information on the manner in which airspace is used by Navy and Marine Corps operational squadrons. It is based on a nationwide survey conducted in February and March, 1970. The conduct of the survey is described, and examples of the application of selected data are given. With emphasis on the interaction between operational flight training and the National Airspace System, statistical data is assembled on the use of airways, the Positive Control Area, Warning Areas, Restricted Areas, and related aspects of Naval flight activity.

CRC 162
DeVany, Arthur S., "The Value of Time in Air Travel: Theory and Evidence," 39 pp., Apr 1971, AD 725 480
The problem of this paper is to analyze the role of time and money cost in the demand for air travel. The first step in the analysis is to construct the theory of consumer demand under a time constraint and to deduce its theorems. Then these theorems are applied to air travel through the use of a total price demand function. This analysis considers the effects of fare, trip time, airport delay, schedule frequency, trip distance, traveler's wage rates, and non-wage income on the demand for air travel.

CRC 163
DeVany, Arthur S. and Garges, Eleanor, "A Forecast of Air Travel Demand and Airport and Airway Use in 1980," 44 pp., 5 Feb 1971, AD 720 732
The demand for air travel between 581 pairs of domestic cities, which comprise 60 percent of total U.S. domestic air travel, is analyzed and forecast to the year 1980. An assessment of operating economies of new wide-body aircraft and alternative trip times likely to be experienced by future air travelers is made to generate assumptions regarding the structure of future fares and trip times by distance. These assumptions are combined with income and population projections for each city and an estimated demand function to

forecast levels of passenger travel between each pair of cities. Airline flights between these pairs of cities are projected under 2 patterns of service that may evolve with the further introduction of wide-body jets into commercial service.

CRC 164
Bram, Joseph, "A Computer Program for Unbalanced Analyses of Variance," 13 pp., Oct 1970, AD 718 354
A computer subroutine which performs an analysis of variance on any set of x_{ijk} with 3 indexes or less, i.e., where the measurements x_{ijk}, assumed normal, may depend on up to 3 different factors is described. The number of samples for each (i,j,k) may vary with (i,j,k). In cases where there are more than 3 factors, the subroutine can still be useful; the user can choose 3 factors from the class of relevant factors in various ways (essentially aggregating the others). A duplicate of the program deck can be obtained from the author.

CRC 169
Kaatz, Leon M., "A Simulation and Queueing Model for the Study of En Route Air Traffic Systems," 41 pp., 22 Feb 1971, AD 721 726
Air traffic congestion at airports and along major jet routes are the primary sources of concern with the airspace system. This paper describes 2 related mathematical models to study these problems. The first model is a simulation of en route traffic. It defines a quantity called the congestion index and relates this to the level of air traffic and the level of investment in the air-space system. The second model is a queueing model used to study congestion and average flight delays at points of jet route intersections. The models consider only high altitude IFR flights but allow for parameterization of plane speeds, separation criteria, available jet routes, and airport operations capacity.

CRC 170
Forst, Brian E. and O'Neill, David M., "The Determinants of Personnel Turnover Costs and Accession Requirements: A Steady-State Model," 12 pp., 3 Feb 1971, (Published in "Studies Prepared for the President's Commission on an All-Volunteer Force," Nov 1970; See also B 13)
This research contribution develops a model which can be used to estimate changes in labor turnover costs that will result from changes in a host of behavioral and other parameters: any voluntary re-enlistment rate; any involuntary loss rate; lengths of boot camp and "A" school training;

CRC 170 – Continued
pupil-teacher ratios in boot camp and in "A" school; duration of on-the-job training, etc. Once the various parameter values have been specified, calculations can be carried out in a matter of minutes on a hand calculator.

CRC 172
Jepson, Joy N., "Financial Obligations by DOD for Military Research and Development," 22 pp., Dec 1970, AD 725 857
The amounts of money obligated by DOD during 1958-1969 for military research and development are briefly summarized. General trends are shown for the total amounts obligated; the amounts obligated for the new area of DOD interest (astronautics) and the 7 traditional areas of DOD interest (missiles, aircraft, ordnance and combat vehicles, ships and small craft, other equipment, programwide management and support, and military sciences) and the amounts obligated by each department (USAF, Navy, Army, and Defense Agencies). The data summarized was compiled from information submitted to Congress over the past 12 years.

CRC 177
Stoloff, Peter H., "An Exploratory Study of Job Satisfaction, Retention, and Performance of Navy Enlisted Men," 30 pp., Feb 1971, AD 723 559
This paper examines the relationship of 2 aspects of job satisfaction: satisfaction with the work itself (job content) and satisfaction of the job environment (job context) to retention behavior and measures of on-the-job performance of first-term Naval enlisted men.

CRC 180
Augusta, Joseph H. and Hibbs, Norma J., "Estimating U.S. Navy Support Costs," 36 pp., Oct 1971
In an environment characterized by austere budgets and changing force levels, the need to provide estimates of support requirements corresponding to force alternatives has become acute. The procedure described here meets this challenge by incorporating Leontief's input-output analysis into a force cost model. One advantage to this technique is that it allocates support resources to the forces, thus giving insight into the utilization of support by forces. However, its real power is in capturing the existing implicit support relationships and using them to project support resources consistent with specified forces. This approach

does not attempt to find optimal support policies; it does predict the marginal impact of force changes based on a given set of support policies. It can also, if desired, estimate the resource impact if support policies are varied. The input-output model described here was developed for the U.S. Navy but the method has applicability to any large interrelated system.

CRC 183
Bram, Joseph, "Estimating Accuracy Parameters of Rapid Fire Guns," 18 pp., Apr 1971, AD 724 771
To model an engagement involving rapid-fire guns implies the capability of supplying good estimates for the input parameters. Recent CNA simulation studies have exhibited enormous variability in the estimates calculated from samples of impact data. In this paper, the fundamental reasons for these large variances are brought out; new estimates (formulas) with moderate variances are derived; lower limits for the variances are established; and the important parameters, aiming error variance and the round-to-round correlation of the aiming error, are shown to be impossible to estimate.

CRC 185
Corn, Robert J., "An Analysis of Closed-Loop Control of Gun Systems," 33 pp., Nov 1971, AD 735 496
Gun system operation is represented as a first-order Markov process, and an optimum linear filter is derived for closed-loop control of mean square error. Potential improvement is then estimated by contrasting the variance in performance and the auto-correlation for the open-loop system with that for the optimum linearly corrected process.

CRC 186
Brown, George F., Jr., and Perlman, Bernard L. (AQF3, USN), "Optimal Inventory Management for Naval Aviation Support," 38 pp., May 1971 (Presented at the 41st National Meeting of the Operations Research Society of America, Apr 1972) AD 731 066
This paper describes the application of a theoretical inventory model to the problems of management of aviation spare parts. The results of this analysis suggest that the use of such models can be of significant benefit to the Navy, and are relatively simple to implement. Recommended stockage and ordering policies for ten parts currently being provisioned for the F-14 are discussed. Sensitivity analyses suggest several areas in which future studies should be undertaken.

CRC 194

Stephan, Robert A. (Cdr., USN), "The Effects of Shipboard Living Conditions on First-Term Retention Rates, and a Model for the Allocation of Funds Among Habitability Improvements," 37 pp., Sep 1971, AD 732 020

Data from a 1969 study based on a questionnaire is subjected to regression analysis to determine whether shipboard habitability and time in home-port affect retention. Tentative results suggest that they do. A methodology that makes use of the questionnaire responses is proposed to determine the optimal allocation of funds among habitability improvements. Further study is recommended, including a new questionnaire and survey.

CRC 197

Butterly, Peter J., "Position Finding with Empirical Prior Knowledge," 16 pp., 1 Dec 1971, (Published in transactions of the IEEE on Aerospace and Electronic Systems, Vol. AES 8, No. 2, Mar 1972) AD 735 112

Information on the position of a source of radiation is often obtained from bearing observations made from two or more known locations. In this communication some criticisms of existing procedures are enumerated and a new approach proposed. This approach allows for the incorporation of knowledge existing before the observations are made and provides simple computational procedures for estimating the source position and for ascertaining the new state of knowledge from the data furnished by the observations.

CRC 201

Allbritton, A. Slagle, Lockman, Robert F., and Stoloff, Peter H., "Motivational Factors in Accession and Retention Behavior," 139 pp., Oct 1971, AD 738 485

Motivational factors in accession and retention behavior of Navy men were identified in a re-analysis of 3 past surveys. Economics, psychological, and personal history variables were found to be of joint importance in predicting enlistment and reenlistment behavior. Better measurement of these kinds of variables should result in improved predictions and policy control mechanisms.

CRC 202

Bram, Joseph, "Estimation of Aim-Error Correlation, Aiming Dispersion, and Ballistic Dispersion," 26 pp., Dec 1971, AD 738 486

This study is based on the attempt to estimate efficiently the statistical parameters describing a rapid-fire gun system. It shows how the likelihood function of the unknown statistical parameters can be quickly and simply calculated. The likelihood function is used here as the basis for estimating the parameters, and the results of the estimates, applied to a large number of computer simulations are summarized.

CRC 203

Forst, Brian E., "An Analysis of Alternative Periodic Health Examination Strategies," 16 pp., Oct 1972 (published as a chapter in "Benefit-Cost and Policy Analysis," edited by William A. Niskanen et al., Aldine Publishing Co., Chicago, 1972), AD 755 494

Data from the Armed Forces were investiaged to enable inferences as to the benefits and costs of alternative periodic health examination strategies. The period health screening program is treated on two levels: first, it is viewed as a production process whose output is the ability of the program to detect illness and whose inputs are the frequency of the examinations and the scope of an examination. Then, at a second level, the respective effects of variations in age and variations in the ability of the periodic health screening program to detect illness, upon the rate of serious morbidity in the population, are examined. Implications of this and related studies for policy regarding periodic health examination programs are discussed.

CRC 206

Lewis, Chantee (Capt., USN), "The Use of Simultaneous Equation Models for Decisions Pertaining to the 'Best' Mix Between Aircraft, Spare Parts, Support, Equipment and Support Personnel," 98 pp., May 1972, AD 747 972

This is the study of the application of production functions to sea-based tactical air resources; aircraft, spare parts, support equipment, and support personnel. The goal is to develop objective criteria for allocating money among these competing demands using sorties or aircraft ready hours as the output.

CRC 212

Birch, Jeffrey B. (USN) and Spruill, Nancy L., "User's Guide to the NARF Workload Planning and Budgeting Model," 146 pp., Jan 1973, AD 763 476

The Navy's Aeronautical Depot Maintenance Program, at an annual cost of over $600 million, includes the rework of aircraft, engines, and components performed at seven Naval Aircraft Rework Facilities, commercial sources, and the rework

CRC 212 — Continued
facilities of the other services. The User's Guide presents a complete description of the Workload Planning and Budgeting Model. This model produces detailed production plans and budgets for the entire Depot Maintenance Program. Using the method of linear programming, the model determines minimum cost workload assignments which satisfy all depot maintenance requirements.

CRC 214
Brown, Jr., George F. and Rogers, Warren F. (Cdr., USN), "A Bayesian Approach to Demand Estimation and Inventory Provisioning," 23 pp., Jul 1972, AD 748 608
This research contribution addresses the problem of explicitly taking into account uncertainty about the demand for spare parts in making inventory procurement and stockage decisions. The model described provides for a unified treatment of the closely related problems of statistical estimation of demand and resource allocation within the inventory system, and leads to an easily implemented, efficient method of determining requirements for spare parts both in the early provisioning phase and in later periods of operations when demand data has accumulated.

CRC 216
Behrns, Vernon N., "A Procedure for the Evaluation of Proposals," 127 pp., Feb 1973, AD 763 754
This research contribution provides an impartial and objective method for selection of the best among several research and development proposals. It provides for a statistically designed evaluation of the proposals by a review board followed by analysis of the evaluation scores by an analysis group. Included are guidance for selection of points for evaluation, a check list of tasks to be accomplished, and full instructions for mathematical analysis of the evaluation scores.

CRC 218
Brown, Nicholas (Cdr., USN), Carroll, Hugh E. (LCdr., USN), and Stephan, Robert A. (Cdr., USN), "Comparison of Navy and Air Force Administrative and Disciplinary Discharges," 32 pp., Jul 1972, AD 752 500
Navy administrative and disciplinary loss rates are examined to determine the effect of mental group and education mix. Navy and Air Force disciplinary and administrative discharge rates are compared. Costs associated with the administration of the Navy's disciplinary system are developed. A methodology is presented for determining the cost of Navy first termers discharged prior to the expiration of active obligated service.

CRC 222
Perlman, Bernard L. (AQF3, USN) and Schwartz, Arnold N., "A Phased-Procurement Model for Application of F-14 Spare Parts Provisioning," 20 pp., Nov 1972, AD 758 354
When a new aircraft, such as the F-14, is being bought, decisions on the quantities of spare parts to be bought are made even though information on expected demands, operating programs, and the final configuration of the aircraft is limited. For high-value, low-usage parts, which are those considered, the minimum-cost strategy might be to defer procurement until demands occur. During the period of deferral, the Navy would buy the needed spare parts from a stock carried by the manufacturer or from the production line if no stock is held. This paper describes an algorithm for determining in what cases this would be the best policy.

CRC 223
Allbritton, A. Slagle, Lockman, Robert F., McKinley, Jr., Harold H. (LCdr., USN), and Stoloff, Peter H., "Development of the Navy Human Relations Questionnaire," 62 pp., Oct 1972, AD 757 760
A questionnaire devised by the American Institutes for Research (AIR) for evaluating a Marine Corps race relations program was adapted for Navy use. This technique was developed for measuring the racial attitudes of Navy personnel. The questionnaire is useful in assessing attitudes of recruits and officer candidates preparatory to conducting human relations briefings. It is useful to sea and shore commanders for better understanding the racial attitudes of their personnel. Finally, it can be used before and after human relations training to evaluate the effects of training.

CRC 224
Wilmer, Jr., John W. (USN), "Handbook of Judicial Decisions (through 20 October 1972) Involving Environmental Impact Statements," 107 pp., Nov 1972, AD 757 060
Reference to recent judicial decisions affords a useful means by which Federal agencies can arrive at or confirm their decisions on environmental

CRC 224 – Continued

impact statements. This handbook presents the reasons of reviewing courts for their decisions, arranged into a logic of outcomes, summarized in headings, and excerpted from the opinions. Indexes to the cases, the reviewing courts, and key topics are provided.

CRC 225

Klein, Steven W. and Thoureen, Thomas H. (Cdr., USN), "Aircraft Force Projection Model, Volume I, User's Guide to AFPM," 289 pp., Mar 1973, AD 767 946

The Aircraft Force Projection Model (AFPM) is designed to project the Navy's aircraft inventory over a ten-year period and attempts to satisfy the operating requirements of a given set of forces with the projected operating inventory. In addition the AFPM generates useful characteristics of the aircraft inventory such as projections of the age distributions, attrition quantities, pipeline requirements, and rework requirements. This volume describes the input data file, file maintenance procedures, and how to run the model.

CRC 226

Sasser, John M., "User's Guide to Program UPDATE for the Navy Resource Model," 11 pp., May 1973, (Also see M 1013) AD 764 553

The Navy Resource Model (NARM) is a system of computer programs which provides the capability to cost a total Department of the Navy program. Attached to the basic cost model are many peripheral programs that serve important functions. This paper focuses on the use of one such program, UPDATE. UPDATE's function is to provide the NARM user with a flexible method of changing the data base. It is intended to be a guide for the new or casual user as well as a reference for the experienced user.

CRC 229

Butterly, Peter J., "Position Finding in the Presence of Parametric Uncertainty," 19 pp., Jan 1973, AD 756 251

The first part of this paper is a review of previously established results in a general treatment of position finding, the object of which is to establish comprehensive procedures applicable to all of the Navy's position finding problems. This review illustrates how such problems are influenced by quantities that appear as parameters in the formulation of the problem. The second part

extends the treatment to the case where knowledge of these quantities is uncertain.

CRC 232

Allbritton, A. Slagle, Lockman, Robert F., McKinley, Jr., Harold H. (LCdr., USN), and Stoloff, Peter H., "An Analysis of First-Term Reenlistment Intentions," 77 pp., Nov 1972, AD 784 971

Response to a survey questionnaire that included measures of psychological, economic, and demographic variables were related to the reenlistment intentions of over 3,000 first-term Navy enlisted men on sea duty. The major correlates of reenlistment intentions were related to satisfactions with various aspects of Navy life, motivations underlying enlistment decision, and desires for greater compensation.

CRC 235

Carroll, Hugh E. (LCdr., USN) and Jehn, Christopher, "Navy Recruiting in an All-Volunteer Environment," 32 pp., Jul 1973 AD 779 059

In FY 1972, non-prior service accessions to USN fell below stated requirements. The causes of the FY 1972 Navy recruiting shortfall are analyzed. Productivity of recruiting resources and alternative recruiting strategies are discussed. Data on the draft lottery from January 1970 to August 1972 is used. Recommendations for policy changes and future research are made.

CRC 242

Sinal, Fred R. (RD3, USN), "On Fuzing Geometry," 25 pp., Apr 1973, AD 763 993

The general problem of hitting a moving target with fragments ejected from a gun projectile is solved, and algebraic relationships of the solution are presented. The problem is posed and solved in the context of a proximity fuzed gun-launched projectile intercepting an airborne target. Solutions are presented for both the case in which the ejected fragments do not suffer velocity decay and for the case in which decay occurs. Sample problems are solved and graphical representations of the solutions are given.

CRC 244

Bram, Joseph, "The Discrete Evasion Game," 27 pp., Oct 1973, AD 769 228

Theoretical and computational aspects of the three-move discrete evasion game are presented. An evader strategy is given that yields an upper

CRC 244 – Continued
bound of .2890 for the game-value, and a Marksman strategy is given that yields a lower bound .2842. A particular form for the Marksman strategy is presented which depends on r bits of information, and it is proved that this type of strategy is near-optimal. The results are also applied to the two-move game, which was solved earlier by other workers.

CRC 245
Holcombe, Randall G., "The Economic Impact of Interruption in United States Petroleum Imports: 1975-2000," 110 pp., Nov 1974, AD A010 914
This paper estimates U.S. dependence on foreign oil for the period 1975 through 2000 and examines the economic effect on the U.S. of an interruption of this oil.

CRC 247
Jehn, Christopher and Carroll, Hugh E. (LCdr., USN), "Methodology for Using Draft Lottery Data to Estimate Volunteers," 13 pp., Jul 1973, AD 767 325
Methodologies for estimating true volunteers were evaluated using draft lottery data. An appropriate method was identified for predicting the supply of first-term enlistees in a draft-fee environment.

CRC 249
Arcuni, Albert A. (LCdr., USN), Kuzmack, Richard A., and Stephan, Robert A. (Cdr., USN), "The CNA Officer Projection Model," Feb 1974
Vol I: Guide for Users, 55 pp., AD 777 479
Vol II: Guide for Programmers, 27 pp., AD 918 422L
The Officer Projection Model (OPM) projects the flow of officers through he ranks of the U.S. Navy. It projects an initial officer inventory (characterized by length of service, grade, and promotion status) in yearly increments, accounting for attrition, promotion, legal constraints (Title 10 of the U.S. Code), and such management policies as minimum accession requirements and end strength targets. It is devoted especially to simulating the Navy's officer promotion system, and provides several options which consider the interactions of flow point, promotion rate, zone size, grade structure and end strength, and early and late selection. The OPM will also compute annual compensation, separation pay, retirement pay for the remaining life expectancy of projected retirees. The model provides

management with a tool for evaluating alternative promotion policies and retirement proposals, and for studying the interactions of officer end strengths, promotions, and accessions, and the cost of changes in longevity and grade structure. The Guide for Users, Volume I, describes the Navy's officer system and the model and discusses the data and policy variables to be specified by the user. The Guide for Programmers, Volume II, provides a detailed explanation of the computer coding as an aid to changing, and making special adaptations of the model.

CRC 255
Breckner, Norman V. and Newlon, Daniel H., "The Oil Security System – An Oil Import Policy for the United States," 66 pp., Jan 1974, AD 779 283 (see also B20)
What should the United States do if some oil imports are cheaper but less secure than domestic energy production? In answer to this recurring question, the Oil Security System provides for more oil security and more imports too. It permits imports from insecure sources, either upon payment of a fee or if backed by commitments of emergency oil supplies issued by suppliers of secure oil. Such commitments, called guarantees, are obligations to sell on the market oil in an emergency from such sources as inventories, existing wells operated below capacity, capped wells, new wells drilled during the emergency, and diversions of U.S. exports of crude oil and refined products. In turn, possession of a guarantee is the qualification for receiving a fee-exempt import allowance. Both guarantees and fee-exempt import allowances would be bought and sold. Importers of oil would choose the cheaper way of importing between paying the fee and acquiring a fee-exempt import allowance. Under the Oil Security System the information on guarantees would at all times permit the government to maintain a detailed plan specifying where oil would come from and when it would be supplied in an emergency. In most situations, substituting an Oil Security System for an alternative import policy would both reduce the cost of importing oil and increase oil security in the form of emergency oil supplies.

CRC 256
Kinkade, Joseph D. and Simmons, Robert H., "User's Guide to the Report Generator for the Navy Resource Model," 32 pp., Aug 1974, AD A004 191

CRC 256 – Continued

The Report Generator is a highly generalized information-extracting and report-formatting computer routine. Through a sophisticated command language and system of dictionaries, it can report out information in countless formats and degrees of detail. The description of the Report Generator in this users' guide is for the dictionaries and data files used in the Navy Resource Model (NARM), at CNA. However, it is possible for the reader to apply the Report Generator to his own management information system by creating his own dictionaries for his own data tapes. How to create dictionaries is described in this guide.

CRC 257

MccGwire, Michael K.,* McConnell, James M., and Weinland, Robert G., "Admiral Gorshkov on Navies in War and Peace," 122 pp., 1974, AD A003 071

The series of articles entitled "Navies in War and Peace" by Soviet Navy Commander-in-Chief, Admiral of the Fleet Sergey Gorshkov, are summarized and analyzed by three analysts of the Soviet Navy. Their analyses cover several aspects of the Gorshkov articles: the possibility that they reveal an internal debate over Soviet naval missions and budgets, their implications for the future course of Soviet naval construction, and their meaning for the use of Soviet naval forces in wartime and peacetime.

Dalhousie University, Canada

CRC 266

Linton, Lewis W., "The GLOBALL Computer Program and GLOBEMAP – A Special Purpose Three-Dimensional Plotter Subroutine," 44 pp., Jul 1974, AD 785 869/9GI

GLOBALL manipulates several smaller computer programs to calculate global ranges and surface areas. GLOBEMAP provides a three-dimensional map background upon which the ranges and areas may be presented. This paper is not intended to be a user's manual but to describe characteristics of these models and possible applications of them.

CRC 269

Kleinman, Samuel D. and Shugart, William F. II (USN), "The Effects of Reenlistment Bonuses," 62 pp., Sep 74, AD A009 794

During the period FY 1966-74, the variable reenlistment bonus (VRB) was the primary policy tool used by the Navy to increase retention in enlisted occupations (ratings). Placing the reenlistment decision in an occupational choice framework, this paper employs regression techniques to analyze the effect of reenlistment bonuses on first-term reenlistments, and moreover on lengths of recommitment and second-term reenlistments, two areas that had not been investigated previously. With ratings as the units of observation, data is analyzed for selected intervals up to FY 1973. The results contained in this paper are applied in the Manpower Compensation Study in determining the cost-effectiveness of using Reenlistment bonuses to obtain additional careerists relative to first-termers. The techniques of analysis developed in this paper, as well as the general findings, are equally applicable to the selective reenlistment bonus (SRB).

CRC 271

Aucella, John P. (LCdr., USN) and Stoloff, Peter H., "Estimating the Marginal Balance of Payments Cost of Overseas Homeporting," 19 pp., Dec 1974, AD A006 783

A procedure for estimating the balance of payments cost of overseas homeporting experience is provided in tabular form. By specifying certain characteristics of the overseas homeporting program, such as the ships to be homeported, the area, and the availability of base support, Navy planners can choose the appropriate planning factors to use in the estimation procedure. An application of the procedure using planning factors is shown.

CRC 274

Oberle, Richard A., "An Air Combat Maneuver Conversion Model," 25 pp., Nov 1974, AD A010 539

A model that characterizes an air-to-air engagement as a semi-Markov process is described. Included is a discussion of the Model's assumptions and effectiveness measures with instructions for applying the model to experiments characterizing offensive and defensive maneuvering capability in air combat.

CRC 275

Haas, Christopher B., "A Stochastic Model for the CLAMP Resupply System," 16 pp., Nov 1974, AD A009 398

A method for modeling elements of the Navy's Closed Loop Aeronautical Management Program (CLAMP) resupply system is described and examples presented.

CRC 278

Sanders, David B., "Correlation of DNC-14 Frequency Predictions with Operational Experience," 39 pp., Feb 1975, AD A010 142

Data on frequencies actually used by Navy ships and communications stations is used to compare indicators of quality for those frequencies predicted by DNC-14 to propagate more poorly. The results indicate the extent to which attention paid to DNC-14 predictions can be expected to pay off in reduction of effort required to maintain circuit continuity.

CRC 279

Oberlin, Thomas L., "Message Coding," 89 pp., Apr 1975, AD A014 581

Shortcomings of the Standard Subject Identification Code (SSIC) are identified, and its performance is compared with that of an alternate subject code. Potential uses of the extra information that a good subject code provides are developed, as is methodology for evaluating message codes.

CRC 285

Butterly, Peter J., "Target Tracking: Uniformly Directed Motion from a Normally Distributed Position," 15 pp., Sep 1975, AD A019 070

Following observations of a target position, a set of probabilities, or a position density function, is obtained. If no further information is available, the corresponding probabilities, or density function, after a time interval of arbitrary duration, are obtained from the initial probabilities and an assumed distribution of target course and speed.

Point by point computation of the final position probabilities is always possible, but such a procedure is inefficient where all of the distributions may be specified by means of a few parameters. In this case, a preferred approach is to derive the form of the final position density and compute the values of the parameters necessary for a complete specification from the values of the parameters of the initial position density and the assumed distribution of course and speed.

In this research contribution, the initial position density is bivariate normal. It is assumed that the distribution of target speed may be approximated by a discrete distribution and that the distribution of target course is independent of speed and uniform on the interval 0 to 2π. It is shown that the final position density is expressible as an infinite series of Modified Bessel

Functions and that a formal similarity with a well-documented density could be utilized in the computation of its values.

CRC 287

Butterly, Peter J., "Random Walk Models for Target Tracking," 24 pp., Sep 1975, AD A019 102

Knowledge of the position of a mobile target has often to be ascertained from knowledge of the position at an earlier time and a model of the target motion. The models considered in this research contribution are based on random walk theory and are applicable where the motion is of a complex, time-varying character. Differences in the initial conditions assumed and minor variations in the model account for the different sections. In each case, density and distribution functions are derived for the coordinates of the target.

CRC 289

Poore, Rodger E., "MATCHAR — A Computer Program for Estimating Character Error Rate," 46 pp., Dec 1975, AD A022 966

A computer program for estimating character error rate by comparing send and receive character streams is described and evaluated.

CRC 292

Kaufman, Alfred I., "An Analysis of the Search and Detection Problem," 34 pp., Jan 1976, AD A022 574

A modification of the Koopman framework for search and detection problems is proposed to account for nonuniform probabilities of target arrival. It essentially consists in determining various physical quantities relevant to the search and detection game for any of a family of simple target paths, each one of which is assigned a given probability of having been chosen from the family. The actual value of the physical quantity of interest is then obtained by averaging over the family parameters.

We develop this idea to provide probability densities of target arrival and detection environment. The mathematical structure of the problem is shown to reduce a system of iterative equations that are easily amenable to numerical as well as analytical handling.

The most appealing quality of our formal structure is the capability it has to account for such realistic features of the search and detection game as partial knowledge of target track and correlations along the path of the searcher.

CRC 293

Kaufman, Alfred I., "Modeling the Ocean — Introduction to Wave Propagation in a Turbulent Medium," 55 pp., Jan 1976, AD A023 041

The observation fundamental to this work is that the ocean is usually in a state of turbulent motion. Correspondingly, the value of the temperature at every point in the ocean undergoes irregular fluctuations. In particular, since the index of refraction of the ocean is a function of temperature, we shall take the viewpoint that the refractive index is random and assume that the Kolmogorov theory of locally homogeneous and isotropic turbulence provides a sufficiently good description of the refractive index microstructure. To extract information concerning the randomness of an acoustic wave propagating through this turbulent and unbounded ocean, we make use of the wave equation to connect the statistical properties of the random medium to the implied statistical properties of the wave parameters within the framework of a correlation theory.

We accomplish this only to first order in perturbation theory, thus restricting the realm of validity of our results to high frequencies and small refractive index fluctuations. The structure function of the logarithmic amplitude we find, generalizes similar results of Tatarski and Chernov away from the transversal, correspondingly longitudinal restrictions inherent in their work.

Professional Papers

PP 1

Brown, Jr., George F. and Lloyd, Jr., Richmond M., "Static Models of Bank Credit Expansion," 27 pp., 23 Sep 1969, (Published in the Journal of Financial and Quantitative Analysis, Vol. VI, No. 3, Jun 1971) AD 703 925

The effects of uncertainty on optimal expansion are investigated, particularly in determining whether a bank would ever expand more than if it were faced with a certain world. The effects of a fixed penalty charge assessed whenever the reserve requirement is not met is examined, in addition to a proportional charge on the deficiency. It is shown that the structure of the model does not in general guarantee a finite optimum solution, and further that the stated Federal Reserve penalty structure could easily suggest an infinite expansion to an optimally behaving bank, if it were not for a finite demand for loans at the going interest rate. Finally, the effect of the change in Federal Reserve policy concerning reserve requirements is examined in a static framework.

PP 2

Lando, Mordechai E., "The Sex-Differential in Canadian Unemployment Data," 5 pp., 9 Jan 1970, AD 699 512

This paper attempts to show that the Canadian Labour Force Survey underestimates the number of married women who are in the labor force, but are unemployed. Two estimates are made of the number of unemployed married women. Others have noted that Canada is the only industrial country where females have lower unemployment rates than males. This paper suggests that the anomaly is due to the undercount in the Labour Force Survey. One of the corrected estimates leads to a reversal of the sex-differential and a higher unemployment rate for females than for males.

PP 3

Brown, Jr., George F., Corcoran, Timothy M., and Lloyd, Jr., Richmond M., "A Dynamic Inventory Model with Delivery Lag and Repair," 16 pp., 1 Aug 1969, AD 699 513

An inventory is to be operated over a horizon of T periods during which demands for spare parts arise due to part failure. Successive demands are assumed to be independent and identically distributed random variables. The model considers the periodic review of a single part with backlogging of demand. The decision variables are the amount of initial inventory to stock before departure and the amount of new parts to be ordered during the cruise. New parts are received $\ell 1$ periods after an order is placed. Failed parts are repaired with a given probability and are returned to the inventory $\ell 2$ periods after failure. It is assumed that the order lead time is not less than the lead-time for repair. Ordering costs include fixed plus unit charges, and linear holding and penalty charges are assessed on end-of-period inventory. The model is put into a dynamic programming framework. Optimal ordering policies are shown to be of the (s,s) form, and the existence of an optimal initial inventory level is shown.

PP 4

Kadane, Joseph B., "A Moment Problem for Order Statistics," 14 pp., 13 Jan 1970, (Published in Annuals of Mathematical Statistics, Apr 1971)

PP 4 – Continued
AD 699 514

Necessary and sufficient conditions are given for a triangular array of numbers to be expectations of order statistics of some non-negative random variable. Using well-known recurrence relations, the expectations of all order statistics of the largest sample size, n, in the triangular array, or size up to and including n are sufficient to determine the whole array. The former are reduced to a Stieltjes moment problem, the latter to a Hausdorff moment problem. These results are applied to show that for every sample size, there is a positive random variable with geometrically increasing expectations of order statistics with arbitrary ratio and expectation of smallest order statistic. However, only the degenerate distributions have geometrically increasing expectations of order statistics for more than one sample size, even when the ratio and mean of the smallest order statistic can depend on the sample size. These results were required for a study of participation in discussion groups.

PP 5

Kadane, Joseph B., "Optimal Whereabouts Search," 28 pp., Oct 1969, (Published in Operations Research, Vol. XIX, 1971) AD 699 515

An optimal whereabouts search maximizes the probability of correctly stating, at the end of a search, which box contains the object. This can be accomplished either by finding the object in the search or by guessing correctly, at the end of an unsuccessful search, which box contains the object. Generalizing work of Tognetti, this paper shows that an optimal whereabouts search never searches the box to be guessed. An algorithm is given for finding an optimal whereabouts search strategy.

PP 7

Friedheim, Robert L., "The Continental Shelf Issue at the United Nations: A Quantitative Content Analysis," 25 pp., 7 Jan 1970 (published in "Pacem in Maribus," Vol. 3, edited by Elaine H. Burnell and Piers von Simson, Center for the Study of Democratic Institutions, Santa Barbara, California, The Royal University of Malta Press, 1971; see also PP 28) AD 699 516

It is important to know what states have said in the debate about the problems of the continental shelf. Knowledge of such patterns of opinion on continental shelf problems becomes especially important in the light of the passage of a resolution which calls for the convening of a new international conference to deal with law of the sea problems. Such patterns are discoverable, and, in fact, have already emerged. The tool for explicating these patterns is a quantified thematic content analysis of the seabed debates in the General Assembly and its organs during the 22nd and 23rd Assemblies.

PP 8

Rose, Marshall and White, Alex, "A Comparison of the Importance of Economic versus Non-Economic Factors Affecting the Residential Housing Market During the Two Decades Subsequent to World War II," 122 pp., 15 Jan 1970, AD 699 517

This paper analyzes the various factors which, a priori, appear to have had a substantial influence on the postwar residential housing market. These variables include the age distribution of the population, migration trends, income levels and changes, and the availability of mortgage credit.

PP 9

Rose, Marshall, "A Thesis Concerning the Existence of Excess Capacity at Naval Shipyards Prior to the Escalation of Hostilities in Southeast Asia in 1964," 67 pp., 9 Jan 1970, AD 699 518

Simple and multivariate statistical techniques have been employed to quantify ship overhaul policies to determine if excess capacity existed in Navy shipyards prior to the escalation of hostilities in Southeast Asia in 1964.

PP 11

O'Neill, David M., "The Effect of Discrimination on Earnings: Evidence From Military Test Score Results," 19 pp., 3 Feb 1970, (Published in the Journal of Human Resources, Summer 1970) AD 703 926

The purpose of this paper is to utilize data on the test scores of young men on the Armed Forces Qualification Test in order to make estimates of what the relative importance of current and past discrimination were in explaining 1960 racial differentials in earnings. A quantitative method is devised that, although crude, leads to results that are interesting.

PP 12

Brown, Jr., George F. and Lloyd, Jr., Richmond M., "Dynamic Models of Bank Credit Expansion Under Certainty," 29 pp., 3 Feb 1970, AD 703 931

The purpose of this paper is to investigate the effect of the Federal Reserve policy change of September, 1968, on credit expansion by a single

PP 12 — Continued

bank in response to a change to its reserve level. Prior to that date, the reserves and deposits which fulfillment of the legal reserve requirement was computed were measured over the same time period. Since that date, required reserves for any period are based upon deposit levels two periods prior, creating a different environment under which banks must operate. A dynamic programming model, treating all parameters as if they were known with certainty, is used to investigate the nature of optimal credit behavior under these two environments.

PP 13

Overholt, John L., "Analysis Data Inputs and Sensitivity Tests in War Games," 29 pp., Mar 1971, (Presented as a seminar lecture on war gaming at the Navy Postgraduate School, 19 Oct 1970) AD 722 858

Discusses war gaming as an analytical tool for examining the effectiveness of various alternate courses of action or of military equipment and the role analysis has in the game. The role of historical data and statistical experimental designs for testing the sensitivity of outcomes to changes in the input variables in war gaming are presented.

PP 14

Rose, Marshall, "Determination of the Optimal Investment in End Products and Repair Resources," 38 pp., 18 Feb 1970, (Published in the Annual Meeting of the American Association of Cost Engineers Proceedings, Jun 1971, Montreal, Canada) AD 702 450

This paper demonstrates how to determine the minimal cost combination of end products and investment in repair service capability in order to maintain a given level of operating end products. The model is then applied to the problem of determining the optimal size of the Navy's F-4 aircraft pipeline.

PP 15

Rose, Marshall, "Computing the Expected End Product Service Time Using Extreme Value Properties of Sampling Distributions," 29 pp., 18 Feb 1970, (Published in Operations Research, Vol. XIX, 1971) AD 702 451

In this paper an expression is derived for the expected completion time of a repair project, such as the servicing of end products, when the servicing is composed of a sequence of repair activities on parts of the end product. Each part of the end product is subject to repair with a specified probability and, at first, it is assumed that the completion time of each activity is constant. Subsequently, this assumption is relaxed so that an arbitrary probability distribution can be specified for the repair time of each activity. The concluding parts of the paper show how to compute the expected service time for a particular class of repair activity-time probability distributions.

PP 16

Rose, Marshall, "Study of Reparable Item Resupply Activities," 35 pp., 18 Feb 1970, AD 702 452

This paper is concerned with calculating the significant measures of supply effectiveness for activities which involve the resupply of reparable items (spares). The approach that is taken is to derive an expression for the number of unsatisfied demands existing for the items at a point in time. This expression can then be employed to calculate the desired measures of supply effectiveness which describe the behavior of the model. Several numerical examples illustrating the model's use are also presented.

PP 17

Brown, Lee (LCdr., USN) and Rose, Marshall, "An Incremental Production for the End-Item Repair Process," 17 pp., 3 Mar 1970, (Published in Annual Conference of the American Institute of Industrial Engineers Transactions, May 1970, Cleveland, Ohio) AD 702 453

This article discusses the case of a firm that owns a fleet of end-items and a repair facility for conducting periodic scheduled maintenance of the end-items. If the number of units of operational end-items is less than required, the firm can correct the deficiency by taking several courses of action. The optimal set of actions to be taken by the firm under various assumptions is determined. A numerical example is solved using both mathematical and graphical methods.

PP 18

Rose, Marshall, "Inventory and the Theory of the Firm," 14 pp., 18 Feb 1970, AD 702 454

A serious criticism of the inventory models presented in the literature is that they often seek to minimize inventory costs rather than to minimize

PP 18 — Continued

total costs for a specified production level. This neglect is caused, in large measure, by a failure to consider inventories as factors of production, with substitution possibilities between other types of inputs. This paper incorporates these substitution possibilities into the analysis, and formulates an inventory model within the theory of the firm.

PP 19

Rose, Marshall, "A Decomposed Network Computation for End Product Repair Curves," 24 pp., 18 Feb 1970, AD 702 455

This paper is concerned first with determining the relationship between the repair times of recoverable items and the service time of end products. Afterwards, an algorithm is developed for generating the end product service-time cost curve.

PP 20

Brown, Jr., George F., Corcoran, Timothy M., and Lloyd, Jr., Richmond M., "Inventory Models with a Type of Dependent Demand and Forecasting, with an Application to Repair," 4 pp., 10 Feb 1970, (Published in Management Science: Theory Section, Vol. 17, No. 7, Mar 1971) AD 702 456

In general, the single-product inventory model in which demands in successive periods are not independent is difficult to treat. This paper defines a large class of such problems, when there is a positive lead time for delivery, which can be treated by the classical formulation with a single state variable. All results which hold for inventory models with a constant delivery lag can be shown to hold also for this model. An application is made to a system in which demands are generated by part failure and in which a portion of these failures are repaired after a given (constant or probabilistic) time.

PP 21

Silverman, Lester P., "Resource Allocation in a Sequential Flow Process," 21 pp., 5 Mar 1970, AD 702 457

A stochastic flow process consisting of several independent sub-process stages is considered. At each stage, a probability density function of time to successful completion of the stage by any of the (assumed homogeneous) process items is a function of parameters which are in turn functions of the budget at which each sub-process is supported (decision variables). The process is generalized to allow for the possibility of auxiliary processing at each stage. The problem is to determine the minimum total budget which will yield a desired confidence in the total process being completed by some deadline. The problem is solved under different assumptions about the functional relationship between expenditures and the resulting improvement in process parameters. The fundamental purpose of this paper is to introduce the concept that, in complex systems, the implications of expenditures often are not known with certainty but can be viewed as altering the nature of the underlying stochastic process.

PP 22

Gorlin, Jacques, "Israeli Reprisal Policy and the Limits of U.S. Influence," 27 pp., 23 Mar 1970, AD 703 534

This paper is useful as a remedy for the intoxicating effect of the Arab and Israeli presses. Readers of those presses and generally interested persons will find this paper helpful in striking a balance between what the two presses state or imply about the extent of formal U.S. influence over Israel. It argues that U.S. influence is indeed quite limited, as the Israelis claim.

PP 23

Rose, Marshall, "An Aircraft Rework Cost-Benefit Model," 13 pp., 12 Mar 1970, (Published in the 5th Annual DOD Cost Research Symposium Proceedings, Mar 1970; Available from Xerox-Systems Analysis Section, Webster, New York) AD 702 514

This paper concentrates on one part of a study made at the Center for Naval Analyses from the beginning of 1967 through the end of 1969. The project was called the Aircraft Pipeline Study. This paper describes the theoretical and empirical findings of Phase II of the study.

PP 24

Lloyd, Jr., Richmond M. and Sutton, S. Scott, "An Application of Network Analysis to the Determination of Minimum Cost Aircraft Pipeline Factors," 51 pp., 31 Mar 1970, (Presented at NATO Conference on Problems in the Organization and Introduction of Large Logistic Support Systems, May 1970, Luxembourg) AD 703 536

An important budgeting problem in the U.S. Naval aviation program is to determine the number of aircraft to procure so that a desired level of operating inventory of aircraft is maintained, given that some aircraft will not be

PP 24 – Continued

operational as a result of certain maintenance procedures. This problem became especially important during the Southeast Asia build-up when Navy procurement managers were urged to scrutinize more closely the trade-offs between buying new aircraft and reducing the number of aircraft tied up in maintenance.

PP 25

Saperstone, Stephen H., "An Approach to Semi-Markov Processes," 38 pp., 23 Mar 1970, AD 703 537

This paper reports on some of the mathematical results obtained while seeking to refine Markov chain models used in air-ASW tactical analyses. In an effort to take into account the waiting time in each, a non-Markov process was postulated. Subsequent investigation showed the process to be a reformulation of a semi-Markov process. In the present case, the equations for the flow resemble a multi-dimensional renewal process. The behavior of the system is described by a probability density which characterizes the process at the time $t > 0$, given that the states of the process were defined at time $t = 0$. It is shown in the special steady state case that the probability distribution yields results which are equivalent to those previously given.

PP 26

Brown, Jr., George F. and Corcoran, Timothy M., "The Reliability of a Complex System with Spares, Repair, and Cannibalization," 45 pp., 23 Mar 1970, AD 703 538

The reliability of a complex system is investigated. Special cases of the system include the spare parts or standby redundancy problem and the repair problem, both of which have received wide attention in the literature. Also included in the system is the opportunity for cannibalization. A theorem is given indicating the proper use of this activity. The spare parts problem and the repair problem are analyzed separately. Methods of combining the two analyses are then given in order to obtain bounds and approximations to total system reliability.

PP 27

Fain, Janice B., Fain, William W., Feldman, Leon, and Simon, Susan, "Validation of Combat Models Against Historical Data," 18 pp., 14 Apr 1970, (Published in 9th Symposium of the National Gaming Council Proceedings, Apr 1970) AD 704 744

This topic is divided into two parts. First, model validation in general. In this part some of the difficulties in dealing with historical data is covered and some of the previous validation efforts are discussed. In the second part some of the authors' recent work at the Center for Naval Analyses on an attempt at the validation of our Tactical Warfare Simulation Program using data from the 1950-53 Korean War is described.

PP 28

Friedheim, Robert L. and Kadane, Joseph B., "Quantitative Content Analysis of the United Nations Seabed Debates; Methodology and a Continental Shelf Case Study," 32 pp., 24 Mar 1970, (Published in International Organization, Summer 1970) AD 703 539

Patterns of state preference have emerged and are discoverable through the analysis of the seabed debates. Further, a method of analysis of the data is developed which is appropriate to the problem. The technique is a particular application of quantitative thematic content analysis. How and why this technique can be applied to U.S. debate material, the nature and problems of the method, a case study demonstrating some of the substantive results that were reached, and a statement of our future research priorities are discussed.

PP 29

Saperstone, Stephen H., "Controllability of Linear Oscillatory Systems Using Positive Controls," 27 pp., Apr 1970, AD 704 745

A linear autonomous control process is considered where the null control is an extreme point of the restraint set Ω. In the event that $\Omega = [0,1]$ (hence, scalar control) necessary and sufficient conditions are given so that the reachable set from the origin (in phase space) contains the origin as an interior point. For vector valued controls with each component in $[0,1]$, sufficient conditions are given so that the reachable set from the origin of a non-linear autonomous control process contains the origin as an interior point.

PP 30

DeVany, Arthur S., "The Effect of Social Policy on the Social and Private Value of a Child," 20 pp., 27 Apr 1970, AD 704 746

This paper outlines a hypothesis that relates family size to parental income, potential wage earnings of children, life expectancy of children and certain legal and social institutions that affect the value of a child to the family. It is the

PP 30 — Continued

concern with these institutions that separates the present analysis from other research on the economic determinants of family size. The effect of such institutions as private property, welfare programs, educational programs, the "perfection" of the market for human capital, and the legal rights of women, can be analyzed within the framework provided by the model developed here. A heuristic development of the implications of some possible forms of these institutions is offered. Of central importance in the analysis is the effect of some given institution on the private value of an additional child to the family relative to the social value.

PP 31

DeVany, Arthur S., "Time in the Budget of the Consumer," 51 pp., 27 Apr 1970, AD 704 747

The addition of time in the consumer's budget yields new theorems from demand theory while preserving the logical validity of the old ones. These new theorems concern additional Slutsky-type equations relating quantities of goods demanded, hours worked, and total income to the wage rate, non-wage or time-independent income, and the relative time or price intensity of goods; the Slutsky equations with respect to price are preserved. These new equations place additional behavioral restrictions upon the standard consumer demand functions and permit the consumer's labor supply to be derived from his demand for goods. Since all the theory's variables are observable, it can be tested by estimating these functions.

PP 32

Overholt, John L., "Fitting Korean War Data by Statistical Method," 11 pp., 5 May 1970, (Presented at the 9th Symposium of the National Gaming Council, Apr 1970, Washington, D.C.) AD 705 349

Korean war data obtained from the records of all services is related to U.N. divisions engaged with North Korean and Chinese Communist troops in central Korea in May 1951. The daily record for each division was considered: the strengths and casualties of opposing forces, the amount of ground gained or lost, and fire support as measured in artillery rounds and air sorties. Various graphs display changes in individual variables and in combinations of variables, from day-to-day and with undulations in the battle line as forces concentrated to attack or withdraw. These

plots suggested more sophisticated treatment with the use of multiple regression to fit various proposed relationships. These were relationships between ordnance fired, the intensity of the battle, and the exposure of the troops as indicated by ground gained or lost. Lanchester equations of various types were examined by the incorporation of firepower into the strength and casualty relationships. Some empirical equations were also prepared.

PP 33

DeVany, Arthur S., "A Theory of Household Demand and Labor Supply," 23 pp., 5 May 1970, AD 705 350

This is a model of household consumer unit with two working members. Working time of the wife is allocated to household work or market work according to her market wage rate, and her productivity in household work depends upon the goods consumed by the household, the husband's wage rate, and the family's non-wage income. Theorems derived concern the effect of changes in these income parameters and the prices of goods on the labor force participation of the wife, hours worked by the husband and the goods bundle consumed by the household. One theorem, for example, states that an income compensated increase in the wife's market wage will increase her labor force participation and shorten the husband's work week.

PP 34

Kadane, Joseph B. and Fisher, Franklin M.,* "The Covariance Matrix of the Limited Information Estimator and the Identification Test: Comment," 6 pp., 14 May 1970, AD 706 310

In a recent article, Liu and Breen made 2 major points: (1) they attacked the estimator of Chernoff and Divinsky for the asymptotic covariance matrix of the Limited Information Estimator, because it is not the same as a new estimator they proposed, and (2) they questioned the traditional interpretation of the test of over-identification as set forth by Koopmans and Hood. This paper shows that there is no reason to suppose that the Chernoff-Divinsky and Liu-Breen estimators should be the same. A choice between them should be made on their statistical properties. Also the test of overidentification is examined, and found to do what it is advertised to do.

*Department of Economics, Massachusetts Institute of Technology.

PP 35

Lando, Mordechai E., "Full Employment and the New Economics—A Comment," 4 pp., 14 May 1970, (Published in the Scottish Journal of Political Economy, Vol. XVII, Feb 1969) AD 706 420

Professor Killingsworth's paper "Full Employment and the New Economics" which appeared in the February 1969 issue of the Scottish Journal of Political Economy, contains many controversial hypotheses. This paper avoids the pitfalls of the aggregate demand versus structural change controversy, and comments on some of the strained interpretations Killingsworth places on the data.

PP 36

DeVany, Arthur S., "Time in the Budget of the Consumer: The Theory of Consumer Demand and Labor Supply Under a Time Constraint," 151 pp., 15 Jun 1970, (A dissertation submitted in partial satisfaction of the requirements for the degree of Doctor of Philosophy in Economics) AD 708 348

The purpose of this study is to develop and test a modification of the standard theory of consumer demand that yields implications concerning the consumer's allocation of time to consumption and income producing activities. Unlike the demand for leisure model, the theory presented here does not treat leisure as a good or work as a bad. The consumer's time does not enter his utility function, only the quantities of goods consumed do. The consumer's time enters his budget constraint only. At a sufficiently high level of income, time may also become an additional constraint independent of the budget constraint.

PP 37

Kadane, Joseph B., "Testing a Subset of the Overidentifying Restrictions," 7 pp., 19 Jun 1970, (Published in Econometrica) AD 708 349

Anderson and Rubin derived the likelihood ratio statistic for testing a particular overidentified model against the alternative that the model is just or underidentified. One problem with this test is that consequences of rejecting the null hypothesis are not clear: what restrictions were wrong? Additionally, possibly some of the restrictions are suspect but others, enough to overidentify the model, are not. How the suspect overidentifying restrictions can be tested is the subject of this paper. The likelihood ratio statistic for testing a particular overidentified model against an alternative overidentified model, where all the restrictions on the alternative are restrictions on the null hypotheses are studied.

PP 38

Saperstone, Stephen H., "The Eigenvectors of a Real Symmetric Matrix are Asymptotically Stable for some Differential Equation," 19 pp., Jul 1970, AD 708 502

Let A be a real symmetric n x n matrix. For each real unit vector x we compute numbers $\mu = \mu(x)$ and $\sigma = \sigma(x)$, which have the property that $[\mu + \sigma, \mu - \sigma]$ contains an eigenvalue of A. We establish an autonomous differential equation, dependent on A, which admits asymptotically stable solutions of the form, x = eigenvector of A. This is achieved by noting $\sigma^2(x)$ is a Liapunov function, and tends monotonically to zero along solutions of the differential equation. The set of critical points of $\sigma^2(x)$ are shown to comprise a finite union of products of spheres.

PP 39

Hardy, William C. and Blyth, T. S.,* "QUASI—Residuated Mappings and Baer Assemblies," 21 pp., 14 Jul 1970, (Published in the Proceedings of the Royal Society of Edinburgh, Vol. LXIX, Part II (No. 12), 1971)

This paper considers, for a given ordered set E with minimum element O, the semi-group Q of O-preserving isotone mappings on E and examines necessary and sufficient conditions under which an element $F \epsilon Q$ is such that the left (resp. right) ideal of Q is a principal left (resp. right) ideal of Q generated by a particular type of idempotent. The results obtained lead the authors to introduce the concept of a Baer assembly which is used to extend to the case of semilattice the Baer semigroup coordinatisation of particular types of semilattice.

*Mathematical Institute, University of St. Andrew.

PP 40

Forst, Brian E. and Silverman, Lester P., "Evaluating Changes in the Health Care Delivery System: An Application to Intensive Care Monitoring," 19 pp., 1970, AD 710 631

This paper proposes a tool for evaluation of potential changes in the system for the delivery of health care. Starting with a definition of a community health production function, the paper introduces the concept of nested production functions in health care. The production function approach is seen as providing a mechanism for explicit consideration of the substitution

PP 40 – Continued

and optimal input combination questions which are the basis of all evaluations of changes in the health care delivery system. The discussion of this technique is followed by an application to intensive care monitoring. While actual data has not been gathered, we formulate a model for evaluating the effect of computerization of certain intensive care monitoring procedures.

PP 41

Piersall, Jr., Charles H. (LCdr., USN), "An Analysis of Crisis Decision-Making," 55 pp., Aug 1970, (Published in the American Political Science Review) AD 719 705

This paper analyzes two real crisis situations for the United States; the Cuban Missile Crisis, 1962, and the Gulf of Tonkin Incident, 1964. A crisis decision model is presented to explain the sequential behavior in the referenced cases.

PP 42

Sullivan, John A., "Measured Mental Ability, Service School Achievement and Job Performance," 22 pp., 31 Jul 1970, AD 720 359

Since World War II the Services have used the Armed Forces Qualification Test (AFQT) to screen draftees and enlistment applicants. This procedure assumes that higher scores on the AFQT indicate a higher productivity of individuals to the Armed Forces. This paper examines some of the evidence for this assumption.

PP 43

Forst, Brian E., "Estimating Utility Functions Using Preferences Revealed Under Uncertainty," 11 pp., Jun 1971, (Presented at the 39th National Meeting, Operations Research Society of America, May 1971) AD 726 472

Those who take the normative point of view of decision making under uncertainty typically suggest, sometimes explicitly, that it is sufficient to estimate utility functions on the sole basis of responses to hypothetical questions. This paper, which also takes the normative viewpoint, criticizes that approach on several grounds and proposes the alternative of combining that technique with observations of choices made under uncertainty in real life. The thesis is demonstrated using a fairly common problem in the clinical setting, the case of severe abdominal pain in a young woman. Central to the argument is the distinction between internal inconsistency among a set of responses to abstract questions on the one hand, and disagreement between the choice deemed optimal by the theory and the choice actually revealed as most preferred by the decision maker, on the other. While the former type of inconsistency is the kind most widely treated in the literature, it is reflection upon the latter which will resolve whether the decision maker should rely, ex post facto, upon decision analysis for a particular problem under uncertainty.

PP 44

Schick, Jack M., "Conflict and Integration in the Near East: Regionalism and the Study of Crises," 43 pp., Oct 1970, (Presented at the 66th Annual Meeting of the American Political Science Association, Sep 1970)

The research reported here attempts to supplement regional studies about the Near East in two ways. First, it is a study of the regional effects of four Near East crises as well as of actors' decision-making which is a frequent focus of crisis studies. The effects of external actors upon other external actors in a Near East crisis, of external powers upon local actors, and of local powers upon each other are considered. Secondly, as a comparative study of four crises over a period of ten years, it identifies changes in the crisis roles of actors in the Near East. Comparability is ensured by appropriate scaling methods.

PP 45

Brown, Jr., George F. and Lloyd, Jr., Richmond M., "Fixed Shortage Costs and the Classical Inventory Model," 13 pp., Jul 1970, AD 713 057

Many recent economic and inventory studies have included various types of fixed or lump-sum costs as important determinants of optimal behavior. In this paper, the classical inventory model is augmented to include fixed shortage costs. In general, the presence of fixed shortage costs can lead to complex optimal solutions. The purpose of this paper is to establish a set of sufficient conditions which guarantee the existence of an optimal ordering policy which is unique. The resulting optimal policy is described by a unique set of critical numbers which are bounded and decrease monotonically over the horizon for which the inventory system is to be operated.

PP 46

Hardy, William C. and Blyth, T. S.,* "A Coordinatisation of Lattices by One-Sided Baer Assemblies," 21 pp., Jul 1970, (Published in the Proceedings of the Royal Society of Edinburgh, (A) Vol. 69, 4, 1971/72)

PP 46 — Continued

The notion of *Baer assembly* was introduced in an earlier publication (PP 39), and applied to obtain a coordinatisation theory for semilattices. This was achieved by considering the semigroup of quasi-residuated (*i.e.* O-preserving and isotone) mappings on a bounded semilattice. In the present paper we consider the semigroup of quasi-residuated μ-homomorphisms (or *hemimorphisms*) on a bounded lattice and thus shows how a particular type of one-sided Baer assembly can be used to provide a coordinatisation theory for lattices; and in particular for complemented, modular distributive lattices.

*Mathematical Institute, University of St. Andrew.

PP 47

Silverman, Lester P., "Resource Allocation in a Sequential Flow Process with an Application to the Naval Resupply System," 18 pp., Oct 1970, (Presented at the 11th American Meeting of the Institute of Management Sciences, Oct 1970; Presented at the 26th Meeting of the Military Operations Research Society, Nov 1970) AD 713 028

This paper considers the problem of optimizing the benefits to be realized from allocating resources in a stochastic flow process. The Naval resupply system is viewed as consisting of several processes, from the requisitioning, to processing, to transportation of spare parts. The time necessary for completion of any of the processes by any of the assumed homogeneous items is a random variable described by a distribution function whose parameters are functions of the budget at which each process is supported. Having delineated alternative budget levels and associated parameter improvements at each stage, the problem is to allocate a fixed budget so that the probability of completion for any item over the whole flow system before a given deadline is maximized. The solution to this problem is presented with specific reference to the Naval resupply system.

PP 48

Gray, Burton C., "Writeup for B34TCNA-A Step-Wise Multiple Regression Program," 15 pp., Oct 1970, AD 713 029

The B34T program calculates multiple linear regression in a stepwise manner, inserting at each step that variable which is eligible and has the highest partial correlation with the dependent variable, given that the previously selected variables are in the equation. This paper is intended as a day-to-day guide to the use of B34TCNA. It tells how to punch control cards and implement the options available in the program. There is also a Manual available which describes the workings of the University of Chicago version of the program and its options.

PP 49

Friedheim, Robert L., "International Organizations and the Uses of the Ocean," 88 pp., Oct 1970, (Published in Multinational Cooperation: Economic, Social, and Scientific Development, edited by R. Jordan, Oxford University Press, 1972) AD 714 387

The purpose of this paper is to examine and evaluate a select number of international organizations that have important oceanic responsibilities. Their structure and present functioning are examined and questions about how well they do their job are raised. In addition it must be asked how well do these organizations relate to each other and whether the overall organization of international ocean affairs is satisfactory. Also briefly discussed is the present state of the debate on seabed minerals in the General Assembly.

PP 50

Friedheim, Robert L. and Kadane, Joseph B., "Ocean Science in the United Nations Political Arena," 45 pp., Jun 1971, (Published in the Journal of Maritime Law and Commerce, Vol. 3, No. 3, Apr 1972) AD 731 865

The study of the seabed debates can illuminate attitudes on the use and abuse of science. In this paper the view of states on two broad questions, freedom of scientific research and the future of the Intergovernmental Oceanographic Commission, are measured. In order to place the political problems of ocean science in their proper context, those issues in the larger debate on the future of the oceans which are most closely related to these two questions of ocean science are found. Finally, how science might fare in a future international attempt at legal regulation is estimated.
estimated.

PP 51

Saperstone, Stephen H., "Global Controllability of Linear Systems with Positive Controls," 29 pp., Nov 1970, AD 714 650

In a previous paper by the author and J. Yorke, necessary and sufficient conditions were given for local controllability of linear autonomous systems using only bounded positive controls. The present paper extends those results to obtain conditions for global controllability with both bounded and unbounded positive controls.

PP 52

Forst, Brian E., "A Decision-Theoretic Approach to Medical Diagnosis and Treatment," 14 pp., Nov 1970 (Presented at the Fall 1970, 11th American Meeting of the Institute of Management Science, 21 Oct 1970) AD 714 651

This paper sets out to replace good medical practice with something better by proposing a structure to the clinical decision problem which is, in a particular sense, optimal. The intended contribution of this paper is the proposal to estimate multidimensional utility functions primarily on the basis of observed behavior rather than on the sole basis of response to hypothetical lotteries, as is usually done.

PP 53

Kadane, Joseph B., "On Division of the Question," 12 pp., Nov 1970, (Published in Public Choice, Fall 1971) AD 714 652

Suppose a committee is to write a platform taking positions on many issues. Suppose also that the alternatives for each issue can be ordered so that each member's preferences are single-peaked, and that the issues are separable in the sense that the outcome on one issue does not affect preferences on the others. The committee may consider the issues one-by-one, leading to a platform P* of the majority view on each issue. Alternatively the committee may consider the entire platform as a single motion. If so, there may be a cycle of platforms each of which defeats all platforms not in the cycle. P* is in the above cycle if there is a cycle; if not, P* defeats all other platforms. If division of the questions on amendments is automatically imposed, P* defeats all amendments and from any other platform a sequence of successful amendments leads to P*. This theory is applied to explain why state constitutional amendments tend to fail when submitted as a package, and pass when submitted separately.

PP 54

Kadane, Joseph B., "How to Burgle if You Must: A Decision Problem," 10 pp., May 1971, AD 723 850

A burglar with an initial fortune is contemplating some possible burglaries. This paper considers the maximization of the probability of successfully stealing a target amount and the maximization of expected fortune for the burglar. The burglar model can be extended to include possible policing strategies, as suggested in Anscombe's paper on disarmament and arms control inspection.

PP 55

Brown, Jr., George F., "Optimal Management of Bank Reserves," 35 pp., Aug 1970, (Published in Journal of Financial and Quantitative Analysis, Dec 1972) AD 717 569

In this paper, the effects of various forces on the optimal expansion of credit and holding of reserves are investigated using the techniques of dynamic programming. Discussed in the paper are the effects of uncertainty about reserve losses, various types of penalty costs, costs of adjustment, uncertain future interest rates, and of various institutional structures under which the bank must operate.

PP 56

Horowitz, Stanley A., "Economic Principles of Liability and Financial Responsibility for Oil Pollution," 23 pp., Mar 1971, (Prepared as part of a study by the Program of Policy Studies in Science and Technology of the George Washington University, under U.S. Coast Guard Contract DOT-CG-10-235A) AD 722 376

This paper examines the economic issues involved in the imposition of liability for the damages caused by disasters in general and major oil spills in particular.

PP 57

Lando, Mordechai E., "A Comparison of the Military and Civilian Health Systems," 20 pp., Dec 1970, AD 716 897

This paper compares the civilian health system in the United States to the military's prepaid (at zero price) hospital based group practice system. The military system is found to have higher per capita costs and to use a higher ratio of health personnel to the population. Morbidity data indicates that male civilians are in poorer health than armed forces personnel. Despite lower morbidity rates, hospital utilization is much higher in the military sector. It is suggested that the military could decrease their expenditures on health by reducing hospital utilization.

PP 58

Kadane, Joseph B., "Chronological Ordering of Archeological Deposits by the Minimum Path Length Method," 12 pp., Jun 1971, AD 726 475

A new method of ordering archeological deposits, called the minimum path length method, is introduced and discussed in relation to previous work on the problem. Among its advantages are

PP 58 – Continued

easy computability, independence of input order, and minimization of a reasonably intuitive function of the similarity matrix. Also when the similarity matrix is a Robinson matrix, (which is perfect data for this problem) the minimum path length permutation yields the Robinson order (which is the correct order for a Robinson matrix).

PP 59

Dyckman, Zachary Y., "An Analysis of Negro Employment in the Building Trades," 309 pp., Jan 1971

This study determines the existence and degree of racial discrimination by construction unions and contractors, and examines changes in them that have occurred during the middle and late 1960's. It examines employment patterns of Negroes in the building trades and compares their earnings and employment stability with those of whites. A theoretical framework is developed to assist in understanding some of the economic incentives to discriminate or not to discriminate against Negroes and some of the ramifications of racial discrimination in employment. It empirically tests hypotheses concerning Negro employment and racial discrimination in the building trades and examines current efforts and programs to improve employment opportunities for Negroes in construction and to prognosticate future developments in the area.

PP 60

Lando, Mordechai E., "Health Services in the All-Volunteer Armed Force," 33 pp., Jan 1971 (Published in 'Studies Prepared for the President's Commission on an All-Volunteer Force,' Nov 1970; See B 13) AD 716 899

This study was undertaken in the hope of finding methods to keep down the cost increase for doctors and medical services in the Armed Forces in the absence of the draft. It is assumed that the services now provided will continue in the volunteer context. Given this assumption the analysis attempts to find methods by which these services can be provided more efficiently.

PP 61

Robinson, Jack A., "Classification Management Training and Operations," 13 pp., Jul 1971, (Presented at the 7th Annual Seminar, National Classification Management Society, Washington, D.C., Jul 1971) AD 727 719

This paper presents an approach to classification management training and operations.

PP 62

Brown, Jr., George F. and Schwartz, Arnold N., "The Cost of Squadron Operation: A Theoretical and Empirical Investigation," 10 pp., Jan 1971, (Published in Transactions of the 1971 American Association of Cost Engineers International Meeting, Jun 1971) AD 722 377

The purpose of this analysis is to determine the relationship between the cost of the resource inputs employed by Naval aviation squadrons and the level of output produced by them. Such squadrons employ a mixture of aircraft, maintenance labor, and spare parts in the production of tactically available aircraft. Since these inputs are both substitutes for and complements to one another, the minimum cost combination of inputs capable of producing the desired level of output is sought.

PP 63

Lockman, Robert F., "Analysis of Selection and Performance Measures for CNA Support Personnel," 41 pp., Feb 1971, AD 720 360

The main purpose of the report is to study the validity of the Short Employment Tests scores in relation to the performance ratings of Center for Naval Analyses support personnel. A sufficiently large sample of data has been collected to justify statistical analyses of these measures along with other background and employment characteristics of applicants and hirees.

PP 64

Utgoff, Victor A. and Kashyap, R. L.,* "On Behavior Strategy Solutions in Two-Person Zero-Sum Finite Extended Games with Imperfect Information, Part I: A Method for Determination of Minimally Complex Behavior Strategy Solutions," 35 pp., Feb 1971, (Published in the SIAM Journal on Applied Mathematics, Vol. 22, No. 4, Jun 1972. This work was partially supported by NASA under Grant NGR 15-005-021, NSF under Grant GK-1970, AFOSR under Grant 69-1776; See also PP 73) AD 720 361

In any two-person zero-sum finite extended game with imperfect information, an upper bound on the quality of each player's strategies is established by his choice of a scheme for gathering and retaining the information that becomes available to him as the game progresses. Further, for

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a given game, strategies of the maximum possible quality may exist for each player on a number of information schemes of widely differing complexities. By analyzing the relationship between any given two-person zero-sum finite extended game with given information schemes for its players, and an associated N-person non-cooperative game, a heuristic scheme is uncovered for searching for minimally complex information schemes which support behavior strategies having within ϵ of the maximum possible quality, for any given ϵ. In the course of this analysis, a minimax theorem in behavior strategies is obtained, which is similar to Von Neumann's minimax theorem in mixed strategies.

School of Electrical Engineering, Purdue University.

PP 65

Gray, Burton C., Horowitz, Stanley A., and O'Neill, David M., "Educational Equality and Expenditure Equalization Orders: The Case of Hobson V. Hansen," 43 pp., Feb 1971, (Published in Journal of Human Resources, Vol. 7, No. 3, Summer 1972) AD 720 362

In May, 1970, Julius W. Hobson brought suit in the U.S. District Court for the District of Columbia to seek an order requiring the Washington, D.C. School Board to equalize expenditures per pupil, within a five percent range, among all elementary schools in the system. The major issue in this case is whether ordering equalization of teacher expenditures per pupil will in fact lead to, or even help move in the direction of the attainment of the objective. This report concludes with a summary of findings as well as recommendations with regard to the wisdom of imposing expenditure equalization on the D.C. school system.

PP 66

Schwartz, Arnold N., Sheler, James A. (LCdr., USN), and Cooper, C. R. (Cdr., USN), "Dynamic Programming Approach to the Optimization of Naval Aircraft Rework and Replacement Policies," 1969 (published in the Naval Research Logistics Quarterly 18, 395/1971) AD 720 363

There is a strong effort within the Navy today to improve the aircraft maintenance program. This interest results from the rapid rise in the number of Naval aircraft unavailable for squadron use during the current Vietnam conflict for reasons of maintenance.

PP 67

Kuzmack, Richard A., "Measures of the Potential Economic Loss from Oil Pollution," 12 pp., Mar 1971, (Prepared as part of a study by the Program of Policy Studies in Science and Technology of the George Washington University, entitled, "Legal, Economic and Technical Aspects of Liability and Financial Responsibility as Related to Oil Pollution" under U.S. Coast Guard Contract DOT-CG-10255-A) AD 722 378

The specific problem addressed is that of empirically estimating the potential impact of a large scale oil spill into the public waters on the economy of a nearby coastal community. Taking two areas as case studies, the sensitivity of their economies to exogenous changes in income is estimated using an economic base model. The potential loss is then calculated from the amount of income directly susceptible to oil pollution damages.

PP 68

Blechman, Barry M. and Holt, James T., "Cost/Effectiveness Analysis of Foreign Policy Alternatives: Need, Approach, and Prospects," 36 pp., Mar 1971, (Presented at the Western Regional Meeting of the International Studies Association; March 26-27, 1971; San Francisco, California Panel C-I: "The Relationship of Quantitative Research to Policy-Making") AD 722 379

Three existing macro-approaches to the evaluation of foreign policy alternatives are identified. It is suggested that a variant of one such approach, cost/effectiveness analysis, is the most promising candidate to effect a rigorous, systematic, comprehensive, and fundamental evaluation of U.S. foreign policy. The paper outlines eight steps comprising a cost/effectiveness analysis, describes the subanalyses and other processes contained in each, discusses relevant data sources, and identifies major problems that would be confronted by anyone undertaking such an analysis. The paper also explores the prospects for adoption of the proposed methodology in various sectors of the analysis community and concludes that such prospects are not favorable, for many reasons.

PP 69

Rogers, Warren F. (Cdr., USN), "Exact Null Distributions for Rank Test Statistics," 45 pp., Mar 1971, AD 722 380

Efficient algorithms are developed for inverting the probability generating functions of the

PP 69 — Continued

distributions of rank test statistics. A method is given for deriving probability generating functions in a form suitable for inversion. Cases treated include one and two sample linear rank statistics, the general scores test for regression, and the Kolmogorov-Sirnov test statistics.

PP 70

Rogers, Warren F. (Cdr., USN), "On A Theorem of Weyl," 13 pp., Mar 1971, AD 722 381

If A is a Lebesque measurable subset of the interval [0,1] and t is any irrational number in that interval, then by a well-known theorem of Weyl, the frequency with which the integer products of t modulo one fall in A converges to the measure of A. This result may be used to evaluate asymtotic error in certain approximations. For a special case, Weyl's theorem is shown to extend to rational numbers t and a lower bound on frequency is derived.

PP 71

Lloyd, Jr., Richmond M., "Dynamic Programming Models of Short Term Bank Reserve Management," 219 pp., Jun 1971, (Submitted in partial fulfillment of the requirement for the Degree Doctor of Philosophy, University of Rochester) AD 727 724

A member bank of the Federal Reserve System is required by law to hold a certain percentage of its deposits in the form of reserves. The reserve requirement must be satisfied on average over a reserve period. Several dynamic programming models of this short term reserve management problem are developed. The objective is to minimize the discounted expected cost of operation over the reserve period. The bank is restricted to one reserve adjustment mechanism, buying or selling funds on the federal funds market. One decision is made for each day within the five day reserve period. The optimal policy for each model is shown to be of a simple form.

PP 72

Kadane, Joseph B. and Iversen, Gudmund R.,* "Estimation of Multinomial Processes When Only the Sum and the Number Governed by Each Process is Observed," 13 pp., Apr 1971, AD 722 382

This paper considers the estimation of multinomial probability vectors when only the sum of several multinomial processes is observed, and when the number of individuals governed by each process is known. The relationship of this problem to the previous literature is discussed, the likelihood function is given, the identification

problem is also considered, and an algorithm is proposed for finding maximum likelihood estimators.

*University of Michigan.

PP 73

Utgoff, Victor A. and Kashyap, R. L.,* "On Behavior Strategy Solutions in Two-Person Zero-Sum Finite Extended Games with Imperfect Information, Part II: Determination of a Minimally Complex Behavior Strategy Solution in a Medical Decision Process," 20 pp., May 1971, (Published in the SIAM Journal on Applied Mathematics, Vol. 22, No. 4, Jun 1972. This work was partially supported by NASA under Grant NGR 15-005-021, by NSF under Grant GK-1970, by the AFOSR under Grant 69-1776; See also PP 64) AD 723 851

A medical decision process is considered in which a doctor must make a sequence of treatment and operate-don't operate decisions for a patient on the basis of treatment and diagnosis information which the doctor gathers as he proceeds. By examining a set of N-person non-cooperative games which can be associated with the given medical decision process, a search is carried out for a behavior strategy for the doctor which: (i) comes acceptably close to maximizing the minimum expected lifetime extension of the patient for all possible unknown statistics which may describe the patient's response to inappropriate treatment, and (ii) requires the doctor to gather and retain the minimum amount of information. The search yields a behavior strategy with more than 90 percent of the effectiveness yet less than 10 percent of the complexity of the most effective behavior strategy.

*School of Engineering, Purdue University.

PP 74

Brown, Jr., George F., Silverman, Lester P., and Perlman, Bernard L. (AQF3, USN), "Optimal Positioning of Inventory Stock in a Multi-Echelon System," 33 pp., May 1971, (Presented at the 39th Annual Meeting, Operations Research Society of America, May 1971) AD 723 852

This paper considers optimal stockage and resupply policies for an inventory system in which the cost and time for resupply can be altered by various logistical expenditures, including the pre-positioning of parts at intermediate echelons of the system. At stations on the lowest echelon, demands arise due to part failure. With some probability, the part can be

PP 74 – Continued

repaired at this echelon. Spare parts may be obtained from inventory, through repair, or by ordering after a delivery lag. Minimum cost stockage and reordering rules are derived for each echelon, as a function of the delivery lag. This analysis is combined with a study of the effects of expenditures on the resupply system itself. An application of the procedure to the Naval aviation support system is described.

PP 75

Stoloff, Peter H., "The Navy Personal Response Program: Review, Evaluation, and Recommendation," 21 pp., Jul 1971, AD 727 725

The Navy Personal Response Program is a cross-cultural training program aimed at developing the skills necessary for effective communication with our foreign hosts. The purpose of this paper is to review the Navy's Personal Response Program and to define the steps necessary to make it a workable program.

PP 76

Canes, Michael E., "Measurement and Selection of Defense," 19 pp., Aug 1971, AD 731 868

This paper suggests a measure of the value of defense; namely, reduction in the cost of repairing or replacing capital items subjected to attack. Using this measure, a decision rule is advanced that allows calculation of how much resource to devote to defense. The suggested decision rule is argued to be superior to two alternatives: (a) a "budget" rule that maximizes defense subject to a budget constraint, and (2) a "requirements" rule that minimizes cost subject to a required level of defense. The practical use of the suggested decision rule is discussed and some possible applications given.

PP 77

McConnell, James M., "The Soviet Navy in the Indian Ocean," 15 pp., Aug 1971, AD 731 869

Though Soviet warships have been in the Indian Ocean since 1968 Western analysts are still wrestling with the problem of motivation. The reasons for the Soviet presence is the subject of this paper. Soviet naval missions are discussed, illustrated with examples of Soviet actions, and Soviet requirements and activities in the Indian Ocean itself are examined. Observations on Brezhnev's recent proposals for naval limitations in both the Mediterranean and the Indian Ocean are also included.

PP 78

Blechman, Barry M., "A Quantitative Description on Arab-Israeli Interactions, 1949-1969: Data Sets and Processor," 40 pp., Sep 1971, AD 731 870

This paper documents two sets of data compiled by the author which describe some aspects of Arab-Israeli relations between 1 Jul 1949 and 30 Jun 1969. The data sources, coding procedures and possible biases incorporated in each set are discussed. In addition a computer program, "Mid-East," is documented, which can be used to process one of the data sets.

PP 79

Brown, Nicholas (Cdr., USN) and Wilson, Jr., Desmond P., "Warfare at Sea: Threat of the Seventies," 14 pp., 4 Nov 1971, AD 734 856

This article contends that a new stragetic environment is emerging. It is an environment in which the rivalry between the Great Powers will have an increased potential for developing into direct armed conflict in the maritime areas. In this environment where both U.S. and Soviet capability for massive retaliation against a thermo-nuclear attack is unquestioned, the novel element is the Soviet Navy. It has attained a size and operating proficiency that transforms the USSR into a maritime power fully capable of threatening the security interests of the economically-advanced nations of the Free World. As a consequence U.S. military planners, who have been accustomed to thinking in terms of direct conflict in Europe, must now also think in terms of the growing potential for direct conflict at sea. Indeed, it is the authors' view that of these two areas for opening conflict, the sea is the more likely, with the limited involvement chiefly of naval forces. This is a possibility that has significant implications not only for our allies, but also for our total force planning.

PP 80

Weinland, Robert G., "The Changing Mission Structure of the Soviet Navy," 14 pp., Nov 1971, (Presented at a meeting of the International Institute for Strategic Studies, London, Oct 1971; Published in Survival, XIV, No. 3, May-Jun 1972; Reprinted in Congressional Record, 31 Jan 1972) AD 734 077

This paper discusses significant changes in the character of Soviet naval operations and how these changes reflect a modification of the Navy's mission structure. It points out that the West should be more aware of the changes and there implications.

PP 81

Forst, Brian E., "The Grisly Analytics of Death, Disability, and Disbursements," 18 pp., Nov 1971, (Presented at the 40th National Meeting, Operations Research Society of America, Oct 1971) AD 732 555

In a large class of decision problems under uncertainty, death, disability, and reductions in wealth enter the analysis as crucial arguments in the utility function. Much of the literature in public health and safety programs, insurance programs, and clinical decision making concerns itself with optimal behavior in the presence of risk in these variables. This paper sets out, primarily, to describe the assumptions which typically underlie these analyses and demonstrate why they may be too restrictive for models which deal with the death, disability, and disbursement variables. An alternative scheme is proposed.

PP 82

Forst, Brian E., "A Doctor's Introduction to Decision Analysis," 17 pp., Nov 1971, (Presented at the Engineering Foundation Conference on Quantitative Decision Making for the Delivery of Ambulatory Care, Jul 1971) AD 732 556

Decision analysis provides a framework which is well-suited for the doctor who, when presented with a complicated patient management problem, would like to augment his judgment by breaking down the problem into components that he can more readily think about. The doctor's diagnosis and treatment strategy options are evaluated by calculating the expected disutility of each. The axioms upon which this criterion is grounded are presented in this paper in nonformalistic language, and the analysis is demonstrated using a problem quite common in the clinical setting.

PP 83

Horowitz, Stanley A. and Weiher, Rodney F., "The Relative Costs of Formal and On-the-Job Training for Navy Enlisted Occupations," 44 pp., Nov 1971, AD 734 857

The purpose of this study is to determine, in as many ratings as possible:

1. which major skills can be learned on the job;
2. the time paths of skill acquisition—the learning curves—for non-A-school grads and for A-school grads. This goes one step further than merely determining if a skill can be learned on the job;

3. the relative costs of training third-class petty officers via formal training and OJT. This makes it possible to examine whether skills should be taught on the job, once it is known that they can be taught on the job.

PP 84

Horowitz, Stanley A. and Weiher, Rodney F., "A Production Function for Trained Recruits," 27 pp., Nov 1971, AD 734 858

The purpose of this study is to determine the output capability, or capacity, of the Navy's initial entry training bases under current and alternative operating policies, as well as under various output requirements associated with alternative force levels. This paper also examines the question of whether the Navy should have more or less than 3 training bases, and how output should be divided among these bases in the short-run. The basic framework of the study is an econometric estimation of a production function for trained recruits. A brief discussion of production function is contained in the appendix.

PP 85

Brown, Jr., George F., "Comparison of Forecast Accuracy When the Disturbances Are Small: Directly Estimated Reduced Forms vs. K-Class Induced Reduced Forms," 17 pp., Dec 1971, (To be published in the Journal of the American Statistical Association) AD 736 355

In this paper, we consider forecasts based upon (1) reduced forms estimated directly and (2) reduced forms derived from structural equations estimated by k-class methods. Using the method of small—asymptotics, the asymptotic expected mean squared error of any linear combination of forecasts is derived in both cases. Except in special cases, we show that neither of the two methods of estimation dominated in the sense of having a lower expected mean squared error, regardless of which k-class method is used. This result confirms earlier findings of the same nature based upon a large sample asymptotic efficiency criterion.

PP 86

Harrison, Robert A., "Multivariate Regression Analysis and Slaughter Livestock," 33 pp., Dec 1971, AD 736 356

Throughout its history, the econometric analysis of slaughter livestock has been characterized by diversity of opinion on numerous fundamental issues. The issues include the relationships

PP 86 — Continued

between slaughter weight and prices, changes in consumer preferences for meat, the interdependence of slaughter livestock prices (such as hog, fed cattle, and nonfed cattle prices), the interdependence of prices and storage stocks, and seasonality. The resolution of these issues is discussed in this paper. New techniques are proposed, and regression models based on these techniques are given. The regression equations were used to make monthly predictions for a two-year period beyond the period of the data base for the equations. Conclusions are reached on the economic issues in question.

PP 87

Harkins, James A., "Computer Software: A Major Weapon System Component," 8 pp., Jan 1972, (Presented at the ACM 10th Annual Symposium, Washington Chapter, Jun 1971) AD 736 357

It is not computer hardware that determines the success of an application but rather it is computer software. The development of new military systems or new uses for old systems may or may not involve new computer hardware but, invariably they involve new software. Thus, in fact, it is computer software that has become an integral component of contemporary military systems, and must be explicitly considered when either evaluating or developing such systems.

PP 88

Lockman, Robert F., "An Evaluation of the Applicant Interview Form for CNA Support Jobs," 17 pp., Mar 1972, AD 740 995

A detailed study of the reliability and validity of the CNA applicant interview for support staff positions is carefully evaluated in terms of standardization and future performance of applicants.

PP 89

Barney, Gerald O., "System Dynamics and the Analysis of Social Policy," 26 pp., Apr 1972, (Presented at the XIX International Meeting of the Institute of Management Sciences, Huston, Texas, Apr 4-8, 1972) AD 744 191

A social policy is always imbedded in a feedback structure and associated with the management of one or more social conditions. The policy controls at least some of the actions influencing the condition. Information about the condition (usually incomplete, late and inaccurate information) is the input to the policy. Policy, therefore, operates in a feedback structure in which actions change the condition, and the changed condition, acting through the policy effects future actions. Because feedback loops from the basic element

of structure in system dynamics models this methodology is well suited to dynamic analysis of social policy. System dynamics provides the descriptive power of coupled non-linear differential equations. But the methodology also permits the analysis to be easily communicated to people who have never studied calculus. System dynamics also provide a useful approach to the validation of policy simulations.

PP 90

Heider, Charles H., "An N-Step 2-Variable Search Algorithm for the Component Placement Problem," 58 pp., Oct 1972, (Presented at the 41st National Meeting, Operations Research Society of America, New Orleans, Louisiana, 27 Apr 1972; Published in Naval Research Logistics Quarterly, Vol. 20, No. 4, Dec 1973) AD 740 996

The component placement problem is a special case of the quadratic assignment problem in which the imbedded linear assignment problem is absurd. An important application of the component placement problem is in the design automation of electronic systems development where a satisfactory placement of component modules contributes greatly to the successful completion of the more difficult task of interconnection routine. In this paper, an improved search algorithm is introduced which has the capability of producing near optimal solutions to the component placement problem which are completely reproducible at an acceptable expenditure of computational resources. A second objective is the assessment of the question of how close to optimal are the near optimal solutions.

PP 91

Piersall, Jr., Charles H. (LCdr., USN) and Borgstrom, Robert E. (DP2, USN), "Cost Analysis of Optional Methods of Shipboard Domestic Waste Disposal," 23 pp., Jan 1972, (Presented at the Annual Northeast Regional Anti-pollution Conference at the University of Rhode Island, Jul 1972) AD 744 192

The problem of sewage and waste disposal from U.S. Naval ships is recognized by the highest authorities in the Navy. This paper discusses four optional methods for the disposal of shipboard domestic wastes. The annualized investment and operating cost associated with the implementation of each of the options are presented. The model considers non-nuclear, sea-going surface ships with a manning level greater than 50 men. Estimates were developed on a per ship per class basis and aggregated for the total surface fleet. This approach permits the investigation of

PP 91 — Continued
different combinations of the options by merely specifying the number and type of ships to be considered in any option.

PP 92

Forst, Brian E., "Decision Analysis and Medical Malpractice," 28 pp., May 1972, (Presented at the 41st National Meeting, Operations Research Society of America, New Orleans, Louisiana, 27 Apr 1972; Published in ORSA Journal, Vol. 22, No. 1, Jan-Feb 1974) AD 744 193

Normative decision theory has been applied to the problem of evaluating alternative diagnosis-treatment strategies. The courts rely upon a different set of doctrine in performing the same sort of evaluation. This paper investigates the differences. It is suggested that the alleged malpractice crisis results largely from the application of a set of ambiguous and mutually inconsistent medico-legal principals such as reasonable medical certainty, standards of good medical practice in the community, and proximates cause. The expected utility criterion of decision analysis is proposed as an alternative to this melange, both for the purposes of establishing the existence of negligence and for determining the proper amount of compensation.

PP 93

Zedlewski, Edwin W., "Estimation and Inference in Binary Response Regression," 51 pp., May 1972, AD 744 194

The purpose of this paper is to expand the methodology available to binary response regression. Estimation procedures that do not require replicated experiments are derived for the mutli-parameter logistic model, and inference procedures are developed for an analog to the analysis of variance. The investigations of the distributions of small-sample tests and of locally optimal experimental plans are cursory, but they suggest directions for further research.

PP 94

Weinland, Robert G., "Soviet Transits of the Turkish Straits: 1945-1970—An Historical Note on the Establishment and Dimensions of the Soviet Naval Presence in the Mediterranean," 19 pp., Apr 1972, AD 745 042

This paper discusses Soviet naval activity in the Mediterranean based on data from 1945 to 1970. Although the Soviet naval presence has clearly played a most influencial role in the Mediterranean, little empirical data on these operations has been readily accessible. This discussion attempts to specify a number of the dimensions of these operations, and to provide an empirical basis for making some rough approximations regarding Soviet naval activity in the Mediterranean. These data have been drawn from entirely public sources, but heretofore they have not been readily accessible, nor have they been drawn together in this manner, and in this sense, they do represent something new and revealing.

PP 95

Robinson, Jack A., "The British Official Secrets Act: An Examination," 23 pp., Jul 1972, (Presented at the 8th Annual Seminar, National Classification Management Society, Palo Alto, California, 18-20 Jul 1972) AD 745 043

It has been recommended that the British Official Secrets Act be adapted by the United States. The purpose of this paper is to present the available information on the British law, discuss some facts about its relationship to our own, and offer some observations about its effect on operations.

PP 96

Powers, Bruce F. and Goldberg, Martin,* "Simulation of Rapid Ship Unloading by Helicopter," 11 pp., Jul 1972, (Presented at the 5th Conference on the Applications of Simulation (also known as the 1971 Winter Simulation Conference sponsored by ACM/AIIE/IEEE/SHARE/SCI/TIMS), New York, New York, Dec 1971) AD 748 791

This paper describes a simulation model of the rapid unloading of a ship by helicopter. The commander must decide at what distance to station the ship from the unloading point ashore, how many of his helicopters to use for the unloading, and the grouping of the participating helicopters. This paper describes a simulation model which can assist the commander with his decisions and enable him to unload his ship as rapidly and effectively as possible.

*Northwestern University, Industrial Engineering Department.

PP 97

Friedheim, Robert L., "A Law of the Sea Conference—Who Needs It?," 30 pp., Aug 1972, (Presented at the Symposium on International Relations and the Future of Ocean Space, sponsored by the Institute on International Studies, University of South Carolina, Columbia, South Carolina, Apr 12, 1972. Published in SAIS Review, Fall 1972; Reprinted in The Development Digest, Agency for International Development, Apr 1973; Published as a chapter in a book entitled, "International

PP 97 – Continued
Relations and the Future of Ocean Space," edited by Robert G. Wirsing, Columbia, South Carolina, University of South Carolina Press, 1974) AD 748 792

This paper assesses the state of the negotiations on the law of the sea. It explores the usefulness and productiveness of the discussions in the U.N. Seabed Committee—constituted as the preparatory committee of the Law of the Sea Conference. It raises not only the questions of whether there will be sufficient progress to hold a plenary Law of the Sea Conference in 1973 but also the question of what substantive direction the discussion seem to be taking. It brings out the fact that the world community is relying solely upon this single, indefinite, universal law-making conference to resolve the multiple problems of the increased uses of the sea.

PP 98
Brown, Jr., George F., "Structural Estimation by K-Class Methods and Reduced Form Forecasting," 207 pp., Aug 1972, AD 748 793

In this study, small disturbance asymptotic approximation methods are employed to study the properties of forecasts based upon directly estimated reduced forms and upon K-class induced reduced forms. Theorems are presented giving the small-disturbance asymptotic bias and mean squared error of forecasts based upon reduced forms estimated directly or derived from the K-class estimates of structural parameters. It is shown that neither method of reduced form estimation dominates asymptotically in terms of having a smaller mean squared error for any linear combination of forecasts unless the covariance matrix of structural disturbances is diagonal; then K-class induced reduced forms dominate in the above sense. These results are useful for problems in which the properties of linear combinations of parameters in different equations of the system are of interest, as well as in the study of forecasting.

PP 99
Halpern, Abraham M., "Peking and the Problem of Japan, 1968-72," 42 pp., Jul 1972, AD 749 576

This paper deals with a specific period of China's age-old preoccupation with her most powerful Asian neighbor, Japan. In analyzing the developments of the past four years, the tactics of the Chinese approach to Japan have been carefully observed and considered. Based on these observations, the study presents the possible objectives

which have influenced Sino-Japanese relations, and points out similar actions which characterized China's approach to Japan over the years. It emphasizes the variations to past actions as well, and develops the idea of a newly emerging context of Chinese foreign policy where Japan is concerned.

PP 100
Heider, Charles H., "A Decomposition Procedure for the Quadratic Assignment Problem," 21 pp., Nov 1972, (Presented at the 42nd National Meeting, Operations Research Society of America, Nov 1972) AD 751 215

The Quadratic Assignment Problem is one of many combinatorial optimization problems encountered in operations research where the relationship between the computational running time of the available algorithm and problem size is an increasing polynomial. This paper presents a decomposition procedure for reducing the running time of large QAPs. The procedure incorporates the N-step, Z-variable search algorithm. Running time reductions as well as improved solution values are demonstrated for the Steinberg test problem.

PP 101
Heider, Charles H., "A Computationally Simplified Pair-Exchange Algorithm for the Quadratic Assignment Problem," 28 pp., Nov 1972, AD 756 503

Recently, considerable interest has been generated in efficient assignment problem algorithms as a result of computer-aided design automation system projects. Currently available QAP algorithms can be characterized as being computationally complex and requiring medium to large scale computers for implementation. Computer-aided design applications, however, are frequently centered around small process control computers with limited available memory so that the more sophisticated QAP procedures cannot be utilized. This paper presents a computationally simplified pair-exchange algorithm which has proven to be comparable with the currently available QAP algorithm and which is implementable on a small computer.

PP 102
Schneiderman, S. Bernard, "Raid Recognition Probabilities for Sensor-Oriented Surveillance Systems," 42 pp., Nov 1969, (Presented at the 36th Annual Operations Research Society of America Meeting,

PP 102 – Continued
Nov 1969) AD 761 673

The problem of raid recognition, the ability to discern the occurrence of enemy movement in the midst of innocent background traffic, is studied in the context of sensor-oriented surveillance systems for anti-vehicular and anti-personnel surface operations.

PP 103

Friedheim, Robert L., "Political Aspects of Ocean Ecology," 55 pp., Feb 1973, (To be published as a chapter of "Who Protects the Oceans?," published by the Joint Working Group on Ocean Environment of the American Society of International Law) AD 757 936

It is the purpose of this paper to discuss some fundamental aspects of politics, outline the nature of the world political system and its relationship to ecological problems, and point up a number of politically derived problems on bargaining on ecological questions.

PP 104

Schick, Jack M., "A Review of James Cable's 'Gunboat Diplomacy: Political Applications of Limited Naval Force'," 12 pp., Feb 1973, (Reviewed in the American Political Science Review, Vol. LXVI, Dec 1972)

PP 105

Corn, Robert J. and Phillips, Gary R., "Optimal Correction of Gunfire Errors," 27 pp., Mar 1973, AD 761 674

Stochastic control of error in a discrete system is analyzed for an error model comprized of zero mean uncorrelated and Markovian processes plus a random bias of known functional form. It is shown that the optimal solution in the sense of minimum mean square error is realized with a Kalman filter, a linear predictor, and a storage-feedback device. The system used to illustrate this application is a gun system, and performance comparisons are given for it.

PP 106

Stoloff, Peter H., "User's Guide for Generalized Factor Analysis Program," 42 pp., Feb 1973, AD 758 824, with addendum, 7 pp., Aug 1974, AD 786 311

Factor analysis is a statistical procedure useful in reducing a large set of variables to a smaller, more manageable set. The factor analytic model and its uses are discussed. A detailed description of program card preparation, computational procedures and a sample run are provided.

PP 107

Stoloff, Peter H., "Relating Factor Analytically Derived Measures to Exogenous Variables," 20 pp., Mar 1973, AD 758 820

One of the primary uses of factor analysis is to provide a parsimonious description of the interrelations among a system of variables. This paper presents a method by which factors and exogenous variables can be correlated without the numerically cumbersome process of computing factor scores.

PP 108

McConnell, James M. and Kelly, Anne M., "Superpower Naval Diplomacy in the Indo-Pakistani Crisis," 17 pp., Feb 1973, (Published, with revisions, in Survival, Nov/Dec 1973) AD 761 675

This paper discusses the deployment of U.S. and Soviet fleet units to the Indian Ocean following the outbreak of the Indo-Pakistani War on 3 December 1971. The time sequence of Soviet and U.S. ship deployments is traced with the attempt made to discern underlying policy objectives of such moves.

PP 109

Berghoefer, Fred G., "Salaries—A Framework for the Study of Trends," 15 pp., Dec 1972, (Published in Review of Income and Wealth, Series 18, No. 4, Dec 1972)

This paper proposed that salary structures and the development of salaries over time be considered within the framework of the distribution of income over time. In particular, it examines certain salary scales in the United States and the progressions of typical individuals' salaries during the period 1948-1969, in comparison with the percentile distributions of household income in the same period, as reflected by the Current Population Survey of the Bureau of the Census.

PP 110

Augusta, Joseph H., "A Critique of Cost Analysis," 7 pp., Jul 1973, AD 766 376

This paper concentrates on two broad areas of concern to today's cost analysts; one is procurement costing, the other is force level costing. Both these types of cost analyses have been strengthened in recent years; the latter because of the change in the way OSD manages the planning system—the introduction of Fiscal Guidance—and the former because of the change in the procurement system—the DSARC and the

PP 110 — Continued

independent review system. Discusses how the Fiscal Guidance System works in the Navy; and the use of the Navy Resource Model, or NARM, in estimating the resource implication of a force change.

PP 111

Herrick, Robert W., "The USSR's 'Blue Belt of Defense' Concept: A Unified Military Plan for Defense Against Seaborne Nuclear Attack by Strike Carriers and Polaris/Poseidon SSBNs," 11 pp., May 1973, AD 766 375

In a speech made at the 23rd Communist Party Congress, April 1, 1966, Soviet Defense Minister Marshal Malinovsky made an unamplified reference to a new Soviet military concept which neither he nor any other Soviet leader or publicist has ever again referred to in the public media: "We stand tranquilly and confidentially in the defense of the peaceful work of our people, the more so now when the creation of the Blue Belt of Defense has been completed for our State." This statement generated a wave of journalistic speculation as to the nature of the Blue Belt system and the Soviet forces involved. Examining various media statements, and other open source comments, the paper concludes that the Soviet system is not purely naval. Although the Blue Belt is solely concerned with the seaborne nuclear threat from the strike carriers and missile submarines of the United States and other NATO states, the defense against this threat is a mission shared jointly with other service branches.

PP 112

Ginsberg, Lawrence H., "ELF Atmosphere Noise Level Statistics for Project Sanguine," 7 pp., Apr 1974 (Published in IEEE Transactions on Communications, Vol. COM-22, No. 4 Apr 1974) AD 786 969

Statistics of narrow-band extremely low frequency (ELF) noise for use in Sanguine systems analysis were obtained at locations in Malta and Guam. The results of four seasons of ELF atmospheric noise measurements are discussed. In particular the contributions of local thunderstorms to high noise levels, i.e., the 1 percent exceedance levels are shown. Spectra of the 1 percent and 50 percent exceedance levels of the magnetic-field intensity component, obtained from the sensor aligned for maximum reception from northern Wisconsin are plotted.

PP 113

Ginsberg, Lawrence H., "Propagation Anomalies During Project Sanguine Experiments," 6 pp., Apr 1974 (Published in IEEE Transactions on Communications, Vol. COM-22, No. 4, Apr 1974) AD 786 968

Extremely low frequency (ELF) electromagnetic wave propagation was investigated by measuring the amplitude of a CW signal transmitted from the Sanguine site in North Carolina to receiving sites located in New York State, Labrador, and Iceland.

PP 114

Maloney, Arthur P., "Job Satisfaction and Job Turnover," 43 pp., Jul 1973, AD 768 410

Change models are considered in relation to studies of factors affecting job-change decisions. This background serves as a framework for critical reviews of recent research on job satisfaction and job turnover. The reviews are followed by an analysis of job turnover during a seven-year period at Alpha Corp., a medium-size operations research organization.

PP 115

Silverman, Lester P., "The Determinants of Emergency and Elective Admissions to Hospitals," 136 pp., Jul 1973, (To be published in the Journal of the American Statistical Association (Chapter 1) and Health Services Research (Chapter 2)) AD 766 377

Studies of the demand for hospital services have generally ignored the determinants of arrivals of different types of patients at individual hospitals in a geographic area. To enable efficient resource allocation, the hospital should be able to forecast the demand for admissions of three categories of patients, emergency, urgent, and elective, in specific diagnosis/age classes. This paper examines properties of alternative models for predicting daily emergency admissions in Allegheny County, Pennsylvania, structures a cross-section time-series model of emergency admissions to individual hospitals, and formalizes and tests a descriptive model of hospital admissions decisions on urgent and elective patients.

PP 116

Rehm, Allan S., "An Assessment of Military Operations Research in the USSR," 19 pp., Sep 1973, AD 770 116

This paper has four sections followed by conclusions and an assessment. The first section

PP 116 — Continued
concerns the historical development of operations research in the USSR and related areas along with some comments on the political background in which this occurred. The second section discusses open Soviet military literature in general and is intended to point out both its abundance, and how it shows that they follow our open literature very closely. The third section looks briefly at each of the several Soviet books on military operations research with some comparisons with our own literature. The final section looks at what can be discerned from the literature taken as a whole with regard to personalities, organization, and trends.

PP 118
Barfoot, C. Bernard, "Markov Duels," 13 pp., Apr 1973 (Published in Operations Research, Vol. 22, No. 2, Mar-Apr 1974)
Markov duels are a general class of stochastic duels in which each weapon has Markov-dependent fire, that is, the outcomes of shots by each weapon form a Markov process. This paper develops duel models for the situation in which the outcomes form a finite stationary Markov chain and both weapons have an unlimited supply of ammunition, fire at constant intervals of time, and duel until one is killed.

PP 119
Lockman, Robert F. and Stoloff, Peter H., "Development of the Navy Human Relations Questionnaire," 2 pp., May 1974 (Reprinted from the Proceedings, 81st Annual Convention, APA, 1973) AD 779 240
The purpose of the present study was to design a questionnaire to measure the racial attitudes of Naval personnel. Analysis of the responses to the questionnaire would identify the various attitudes it measures, their interrelationships, and differences in attitudes between groups.

PP 120
Schrimper, Ronald A. and Smith, Michael W., "Economic Analysis of the Intracity Dispersion of Criminal Activity," 29 pp., Jun 1974 (Presented at the Economic Society Meeting, 30 Dec 1973), AD 780 538/5GI
The particular objectives of this study are:
(1) to develop a theoretical model of the crime flows between areas of a city or other urban region, identifying factors determining the flows;

(2) to test hypotheses concerning the effects that causal factors, especially the economic variables, identified in the model have on the generation and occurrence of property crime.

PP 121
Devine, Eugene J., "Procurement and Retention of Navy Physicians," 21 pp., Jun 1974 (Paper presented at the 49th Annual Conference of the Western Economic Association, Las Vegas, Nevada, 10 Jun 1974), AD 780 539/3GI
This paper addresses the problem of Navy physician procurement and retention in the all-volunteer environment, and particularly to assess the scholarship program and the bonus legislation. This paper is based upon a major study which was essentially completed in the summer of 1973 (CNA 1030). It was not possible to update the study, but we have had to take account of certain new developments, especially the bonus legislation just enacted.

PP 122
Kelly, Anne M., "The Soviet Naval Presence During the Iraq-Kuwaiti Border Dispute: March-April 1973," 34 pp., Jun 1974 (To be published in Soviet Naval Policy, edited by Michael MccGwire; New York: Praeger), AD 780 592
The subject of this paper is the visit of Admiral Gorshkov and a contingent of Soviet naval ships to Iraq in April 1973, at the time of the Iraq-Kuwaiti border dispute. First, the events which occurred prior to the arrival of the Soviets behavior are discussed, and a plausible explanation is suggested. The paper concludes with observations on the implications of this diplomacy.

PP 123
Petersen, Charles C., "The Soviet Port-Clearing Operation in Bangladesh, March 1972—December 1973," 35 pp., Jun 1974, AD 780 540/1GI
This paper includes first, an account of the port-clearing operation in Bangladesh; second, an analysis of the political objectives sought by the Soviets in undertaking the operation; and finally, an assessment of the political impact and significance of the operation.

PP 124
Friedheim, Robert L. and Jehn, Mary E., "Anticipating Soviet Behavior at the Third U.N. Law of the Sea Conference: USSR Positions and Dilemmas," 37

PP 124 – Continued
pp., Aug 1974 (To be published in Soviet Naval Policy, edited by Michael MccGwire; New York: Praeger), AD 783 701/6GI

The purpose of this paper is to assess the known probable Soviet positions on a number of major substantive ocean law issues and examine some serious problems the Soviet Union will face in developing its bargaining strategy for the UN conference to be held in the summer of 1974 in Caracas, Venezuela.

PP 125
Weinland, Robert G., "Soviet Naval Operations—Ten Years of Change," 16 pp., Aug 1974 (To be published in Soviet Naval Policy, edited by Michael MccGwire; New York: Praeger), AD 783 962/4GI

The Soviet navy has now been operating continuously on the high seas for a decade. Although its first post-war cruise took place in 1953, and a contingent of Soviet submarines was based in Albania from 1958 to 1961, it was not until 1964 that the Soviet navy established a significant permanent presence outside its coastal waters. Since then, both the scope and intensity of this presence have increased markedly and the Soviets have begun to make active use of their deployed naval forces—not only in the forward defense of their homeland but in the protection and promotion of their overseas interests as well.

PP 127
Dragnich, George S., "The Soviet Union's Quest for Access to Naval Facilities in Egypt Prior to the June War of 1967," 64 pp., May 1974, AD 786 318

This study seeks to identify and elucidate Soviet attempts to secure access to naval facilities in Egypt before the June War of 1967. As far as possible, it describes the methods which the Soviets employed towards that end. The study also seeks to explain why the USSR perceived a need for those facilities, and attempts to identify landmarks in the Soviet effort to obtain access to them. The study also examines the Suez crisis of 1956, the Syrian-Turkish crisis of 1957, and the Lebanon crisis of 1958 for the light which they shed on Egypt's subsequent response to Soviet persuasion and pressure for access to its naval facilities. Where relevant to this question, Egyptian views of the Sixth Fleet and other Western naval forces are examined.

PP 128
Lockman, Robert F. and Stoloff, Peter H., "Evaluation of Naval Officer Performance," 10 pp., Aug

1974, AD 784 012/7GI

The Navy officer performance evaluation form was revised to provide more comprehensive and behaviorally-oriented measures of human relations and task-oriented performance. Supervisors completed current and revised performance evaluation forms for a representative sample of 1121 naval officers. A factor analysis of the revised form items produced three factors, representing human relations, and task-oriented performance and formal communications ability for officers of each rank sampled. Convergent and discriminant validity across forms was demonstrated by the multitrait-multimethod procedure.

PP 129
Holen, Arlene and Horowitz, Stanley, "Partial Unemployment Insurance Benefits and the Extent of Partial Unemployment," 3 pp., Aug 1974 (Published in The Journal of Human Resources, Vol. IX, No. 3, Summer 1974), AD 784 010/1GI

In a paper appearing in *The Journal of Human Resources*, Raymond Munts examined the patterns and incentive effects of partial unemployment insurance benefit schedules. Using evidence on individual workers receiving partial benefits in Wisconsin, Munts demonstrated that implicit marginal tax rates on earnings can have dramatic effects on work behavior. Workers tend to adjust their earnings to increase combined earnings and benefits. He did not present evidence on other sources of variation in partial unemployment benefits. This note reports on a study that investigated the work incentive effects of partial unemployment benefits across states, taking into account all sources of variation that may affect labor market activity.

PP 130
Dismukes, Bradford, "Roles and Missions of Soviet Naval General Purpose Forces in Wartime: Pro-SSBN Operations?" 19 pp., Aug 1974, AD 786 320

This paper deals with the relationship between GPF force levels and capabilities and the SSBN security issue from the Soviet naval policy to re-examine the body of available evidence by asking two questions which have thus far been given scant attention: what kind of threat to their own SSBN's do the Soviets perceive in Western ASW systems? What has been their reaction, if any, to this potential threat?"

PP 131
Weinland, Robert G., "An Analysis of Admiral

PP 131 – Continued

Gorshkov's 'Navies in War and Peace'," 44 pp., Jul 1974 (To be published in Soviet Naval Policy, edited by Michael MccGwire; New York: Praeger), AD 786 319

The first objective of this paper is to describe the publication of "Navies in War and Peace" and summarize the arguments advanced there by Admiral Gorshkov. The second objective is to examine potential links between the publication of his statement and the domestic and international contexts in which it appeared. The third objective is to present some summary judgments on the meaning and importance of "Navies in War and Peace."

PP 132

Kleinman, Samuel D., "Racial Differences in Hours Worked in the Market: A Preliminary Report," 76 pp., Feb 1975 (Paper read on 26 Oct 1974 at the Eastern Economic Association Convention in Albany, New York), AD A005 517

Racial differences in the labor market have been the concern of numerous economic studies in recent years. Black-white differences in earnings, unemployment and labor market activity have been extensively explored for both males and females. Invariably, the studies show racial differences to persist even after standardization of the population. It is the intent of this paper to continue the investigation of labor supply difference. It will draw on a model with the multiple individual household as the center of analysis.

PP 133

Squires, Michael L., "A Stochastic Model of Regime Change in Latin America," 41 pp., Feb 1975, AD A007 912

This paper presents a mathematical model of regime change in Latin America; the model is a finite Markov chain with stationary transition probabilities. A first-order Markov chain was found to fit the data satisfactorily, although there were indications that systematic biases existed. More sophisticated models which relax some of the assumptions of finite Markov chains may result in a better fit between model and data.

PP 134

Root, Richard M. and Cunniff, P. F.,* "A Study of the Shock Spectrum of a Two-Degree-of-Freedom Nonlinear Vibratory System," 38 pp., Dec 1975

The shock spectrum due to the motion of the foundation or isolator mass of a two-degree-of-freedom vibratory system was studied. The system

had a cubic hardening elastic nonlinearity in the foundation or isolator restoring force. The system was impulsively shocked, and analytical, experimental, and numerical methods were used to determine the resulting shock spectrum. The system was studied theoretically in two different ways. An analytic solution was developed using perturbation expansion of the nonlinear equations of motion, combined with an analytic solution for the shock spectrum due to the motion. A numerical solution to the nonlinear equations of motion was developed as well and used to verify the range of validity of the solution developed from the perturbation expansion.

*Department of Mechanical Engineering, University of Maryland

PP 135

Goudreau, Kenneth A., Kuzmack, Richard A., and Wiedemann, Karen, "Analysis of Closure Alternatives for Naval Stations and Naval Air Stations," 44 pp., Jun 1975 (Published in "Hearing before the Subcommittee on Military Construction of the Committee on Armed Services," U.S. Senate, 93rd Congress, 1st Session, Part 2, 22 Jun 73)

This paper compares the demand for support resources at Naval Stations and Naval Air Stations by ship and aircraft loadings planned for FY-74 with the support actually provided in FY-69. It is found that many stations have the capacity to support additional ships and aircraft at standards no worse than those that prevailed in FY-69.

PP 136

Stallings, William, "Cybernetics and Behavior Therapy," 12 pp., Jun 1975 (Published in Journal of Cybernetics, Vol. 4, No. 1, 1974)

This paper discusses the contribution that cybernetics can make to the practice of behavior therapy. It is proposed that the processes underlying behavioral disorders can best be understood using the concepts of cybernetics and that a cybernetic analysis of a given behavioral situation can be helpful in developing a therapeutic strategy. To make these ideas concrete, a specific example —the analysis and treatment of the fear of flying— is discussed. Following this example, conclusions are drawn concerning the implications of the cybernetic point of view for behavior therapy. Finally, what might be called a cybernetic theory of man is introduced, and its relevance to behavior therapy is discussed.

PP 137

Petersen, Charles C., "The Soviet Union and the Reopening of the Suez Canal: Mineclearing Operations in the Gulf of Suez," 29 pp., Jun 1975, AD A015 376

The Soviet Union is a seapower which, like the United States, has sought to meet naval requirements through diplomatic effort. This publication will contribute to a fuller appreciation of the degree to which naval requirements condition Soviet policy in this area of the world.

PP 138

Stallings, William, "BRIDGE: An Interactive Dialogue-Generation Facility," 4 pp., Aug 1975 (Published in IEEE Transactions on Systems, Man, and Cybernetics, May 1975)

An interactive programming system for the generation of man-computer dialogues is introduced. The system consists of an integrated set of tools that are used to define and generate the software for a variety of dialogues. The system is capable of generating dialogues for computer-assisted instruction (CAI), data processing, and the programming of special-purpose applications.

PP 139

Morgan, William F., Jr., "Beyond Folklore and Fables in Forestry to Positive Economics," 12 pp., Aug 1975 (Paper presented at the 1974 Annual Meeting of the Southern Economic Association, Atlanta, Georgia, Nov 1974), AD A015 293

To push economics beyond the stage of folklore requires that we adopt scientific methods in judging the validity of our hypotheses or theories. The process of sorting valid from invalid hypotheses by examining implications about the behavior of decision-makers is an exercise in positive economics. It relies on determining "what is" rather than "what ought to be" or "what is thought to be." Positive economics in this sense is the bread-and-butter of applied economics, and

PP 140 – Continued

yet forest economists have often failed to grasp its significance in some of their important analytic work. This failure has led to the wholesale acceptance of beliefs that are of questionable validity. Two of these beliefs are discussed and they are wrong.

PP 140

Mahoney, Robert B. and Druckman, Daniel,* "Simulation, Experimentation and Context," 36 pp., Sep 1975 (Published in Simulation & Games, Vol. 6, No. 3, Sep 1975)

There is a noticeable trend among simulation designers toward the construction of models of the *middle range* that are designed in an attempt to resolve the tension between the "contextual particularity" of events and the apparent order and organization of events in the form of general laws and theory. This paper is presented as an attempt to underscore this preference both in comparison to more abstract experiments designed to uncover general laws and "real world" experiments designed to describe the uniqueness of particular events. These models are suited both for manipulation and control of variables and for the incorporation of contextual parameters, ensuring some degree of rigor in analysis and interpretation and the capability of permitting an assessment of the extent to which obtained findings generalize to a particular setting.

*Mathematica, Inc.

PP 144

Durch, William J., "The Navy of the Republic of China (Taiwan)," 40 pp., Oct 1975

This paper includes the following topics: the RCN in 1975; historical development, contemporary role; contemporary political clout; and, present trends, future prospects.

SECTION III

B. INSTITUTE OF NAVAL STUDIES

Studies

INS 13

Morton, Anton S., et al., "Navy Manpower Considerations 1970-1980,"

Summary Report, 46 pp., Feb 1966, AD 860 677L

Annex A: Multivariate Study of Enlisted Retention-Phase II (MUSTER-II), 66 pp., Oct 1965, AD 860 673L

Annex A: Appendixes, 288 pp., Oct 1965, AD 860 674L

Annex B: Officer Survey, 137 pp., Sep 1965, AD 860 675L

Annex C: The Naval Career: The Enlisted Man's View, 150 pp., Oct 1965, AD 860 676L

Annex D: On the Use of Reenlistment Probabilities in Classification and Training, 31 pp., Nov 1965, AD 860 665L

Annex E: Means of Investigating Retirement Vesting Options-Recommended Study Design, 27 pp., Nov 1965, AD 860 666L

Annex F: Study Programs Recommended for the DCNO (Manpower and Naval Reserve), 30 pp., Dec 1965, AD 860 667L

Annex G w/Appendixes: Cost/Effectiveness of Reenlistment Incentives, 356 pp., Jan 1966, AD 860 668L

This study describes study programs needed to support manpower management functions, clarifies the effects of factors related to the retention of officers and enlisted men, estimates the cost and effectiveness of proposed programs for alleviating critical shortages, predicts retention rates, and develops screening criteria for selecting and training men who are likely to choose a Navy career. Findings are applicable to manpower management functions of planning, recruiting and selection, classification and training, utilization and retention.

INS 18

Fiekowsky, Seymour, Morton, William W. (Capt., USN), Rose, Marshall, and Schwartz, Arnold N., "Aircraft Pipeline Study, Phase I: Definition and Identification of Determinants," 100 pp., 6 Dec 1967, AD 832 232

This study examines the Navy aircraft pipeline and the factors which determine it. A definition of pipeline is derived and a preliminary analysis is made of probable benefits derived from investments in Navy Aircraft Repair Facilities rather than in additional aircraft. Recommendations are made concerning management procedures for assigning aircraft to rework and maintaining more useful data records.

INS 23

Weiher, Rodney F., "Review of Naval Air Rework Facilities Labor Shortage Problem," Aug 1968, 36 pp., AD 848 375

This study examines aspects of the supply of labor to the Naval Air Rework Facilities to ascertain whether there are shortages of skilled labor, as has been reported by certain managers of these facilities. Several indicators of labor supply conditions are used in the examination, including wages, turnover, job vacancies, and the quality of the work force. The effects of employment ceilings are also examined.

INS 28

Daniels, James M. (Cdr., USN), Brown, Lee (LCdr., USN), Henshall, Joseph (LCdr., USN), Lloyd, Jr., Richmond M., Polyzoides, Carol, Rose, Marshall Sheler, James A. (LCdr., USN), Sutton S. Scott, and Wiedemann, Karen C., "Aircraft Pipeline Study, Phase III: An Applied Model for Determination of Minimum Cost Pipeline Factors," 255 pp., 9 Jan 1970, AD 868 305

This study documents the development of an applied model which can be used as an aid in predicting optimal pipeline factors for planning pipeline aircraft procurement. Using the technique of Network Analysis, the model is illustrated with the A-7 aircraft undergoing Progressive Aircraft Rework (PAR) at Naval Aircraft Rework Facility, Jacksonville. A range of pipeline factors for the A-7 are evaluated and suggestions are made for applying the model to other type, model, and series of aircraft.

INS 32

Brown, Jr., George F., Corcoran, Timothy M., Henshall, Joseph (LCdr., USN), Lloyd, Jr., Richmond M., Prestwich, J. (Capt., USN), Rafferty, Sheila A., Rogers, Warren F. (Cdr., USN), Schwartz, Arnold N., Silverman, Lester P., Sullivan, John A., Sutton, S. Scott, Webster, Burt A. (Lt., USN), and Wiedemann, Karen C., "A Study of Aviation Resources and Readiness Relationship," Jun 1970, (Vol. I) AD 754 084; (Vol. II) AD 754 085; (Vol. III) AD 754 086

INS 32–Continued

This is a study of the relationship between aircraft readiness and spares usage at the squadron level, specifically for the F-4B, CH-53, and TA-4F. The study determines the best combination of aircraft, maintenance man-hours, and spare parts for various budgets. Since the availability of spare parts is a big factor in aircraft readiness, a detailed examination was made of the spare parts resupply system, and recommendations are made for improving this system. Additional recommendations are made for changing the current method of estimating the quantities of spare parts needed for a specific aircraft model.

INS 34

Devany, Arthur S., "An Analysis of Naval Airspace Usage," 209 pp., Oct 1971, AD 893 950

Demands for more airspace and increasing activity in airspace already in use are growing while the amount of airspace available remains fixed. There are already conflicts between civil, general, and military aviation, and it is generally believed that further conflicts are inevitable. This study examines current airspace use over the continental United States and projects such use to 1980. The needs for airspace for Naval training are determined, and the effects on these needs of placing more and more airspace under positive control are weighted. The study makes several recommendations concerning Naval training policies and both general and civil aviation.

INS 38

Askin, Kurt, Birch, Jeffrey B. (USN), Halford, Ralph, Hausler, Carl O. (Cdr., USN), Lloyd, Jr., Richmond M., Spruill, Nancy L., and Vanni, Ralph J. (LCdr., USN), "Naval Aircraft Rework Facility Study—An Applied Model for Workload Planning and Budgeting," 161 pp., 1 Nov 1972, AD 755 462

This study documents a five-year planning model which produces detailed production plans and budgets for the entire Depot Maintenance Program. Using the method of linear programming, the model determines minimum cost workload assignments which satisfy all depot maintenance requirements. Several physical and manpower capacity measures are used to ensure that plans are within the production capabilities of each rework facility. The model allows for multiple shift operations, changes in the size and distribution of the work force, and the assignment of work to non-Navy facilities. A production plan and budget for FY-1974 and various sensitivity

analyses are presented to illustrate the model's uses.

Research Contributions

IRC 5

Freimer, M. L. and Mundo, C. J., "Satellite Identification of Naval Task Forces by Measurement of Population Variance," 18 pp., 31 Dec 1963, AD 828 773

The interrelationships between deployment and sensor parameters are determined for a surveillance satellite used to detect the movements of large naval forces at sea.

IRC 7

Apple, R. E. and Farrar, D. E., "Economic Considerations in Establishing an Overhaul Cycle for Ships: An Empirical Analysis," 29 pp., 13 Apr 1964, AD 624 784

Cross-sectional data from the U.S. Navy's Atlantic Fleet Destroyer Force is analyzed in a three-part study of relationship between a ship's total maintenance cost, time lost from operations, reliability, and the length of its overhaul cycle. Factors such as ship age, size, complexity, usage, etc., are held constant as required. The overhaul cycle is viewed as the primary control variable by which Navy maintenance managers allocate effort between scheduled and unscheduled repairs. A minimum-cost overhaul cycle is obtained. In the absence of defensible cost penalties for time lost and reliability (where the latter is measured by the frequency of unscheduled repair), minimum cost and optimal cycles are not one and the same. Tradeoffs between cost and reliability are obtained, however, and the range within which an optimal cycle may be expected to lie is narrowed considerably.

IRC 10

Payne, Aubrey H., "On Measuring the Value of Information—with Implications for Communications Systems," 23 pp., 8 Sep 1965, AD 624 785

The value of information is defined as the reduction in risk that results from using the information in decision. Information is considered as being of 2 basic types: experience and intelligence (data). A scheme for attaching quantitative measures to these concepts, within the framework of statistical decision theory, is proposed. The resulting model is shown to be compatible with a number of intuitive concepts as to the proper behavior of value in this context. Applica-

IRC 10—Continued
tions to the design and evaluation of communications systems are considered.

IRC 13
Bryan, Joseph G. and Singer, Arnold N., "Prediction of Reenlistment Using Regression Estimation of Event Probabilities (REEP)," 87 pp., 3 Nov 1965, AD 624 786
The statistical methodology of a "package" of computer programs, referred to as REEP (Regression Estimation of Event Probabilities), is described. REEP uses regression analysis techniques to arrive at equations that yield probabilities of occurrence for each of a set of possible events. An application of REEP to predicting reenlistment for enlisted Navy men is given.

IRC 14
Newman, David B., "Channel Capacities of Multiple/Random Access Communications Satellite Repeaters," 21 pp., 29 Nov 1965, AD 627 452
The channel capacity of a communications satellite repeater is of direct interest to all users in assessing how much service they may expect to obtain from a particular satellite or system. This paper develops a graphic means for estimating and portraying link capacities in terms of radio teletype (RATT) and voice channels for bank limiter and linear repeaters of various generic types of communications satellites. The means of estimating link capacities are developed in the paper as a function of certain parameters that pertain to such variables as power, terminal type, error rate, and satellite altitude and stabilization.

IRC 15
Weybrew, Benjamin B., "The Effectiveness of Navy Incentive Programs—Some Methodological Considerations and Preliminary Findings," 69 pp., 11 Mar 1966, AD 720 408
In addition to providing a review of some of the pertinent literature, this paper contains an examination of certain of the dynamics of incentive effectiveness, both in terms of the environmental conditions involved and the patterns of needs and motives of the men toward whom the incentives are directed. The uses and limitations of 4 classes of criteria frequently employed in incentive evaluation are considered from a methodological viewpoint: reenlistment rate, proficiency, adjustment adequacy, and cost-effectiveness. Where feasible, these criteria are used to assess the effectiveness of 3 Navy incentive programs: Selective Training and Retention (STAR), Selective Conversion and Retention (SCORE), and Naval

Enlisted Scientific Education Program (NESEP). Research designs recommended for evaluation of these programs are described. Some considerations as to directions naval incentive planning might take in the future are presented.

IRC 17
Harsh, Charles M., "Predicting Effectiveness of Incentive Programs for Various Groups of Navy Officers," 21 pp., 31 Mar 1966, AD 758 418
This paper develops a method for estimating the effectiveness of officer incentive programs, making allowance for continuance probabilities for officers with different service intentions. Data from the 1965 INS Officer Survey are used to estimate the effectiveness of several combinations of incentives for retaining officers in certain age and designator groups. The study also explores methods for relating incentive appeal to officer quality, career objectives, and source of commission.

IRC 23
Boness, A. James and Schwartz, Arnold N., "Interim Report on the Assignment of Aircraft to the Naval Advanced Jet Pilot Training Mission," 42 pp., Nov 1967, (See A 1023 for revised version) AD 667 574
An interim report on methods of solving aircraft service-life problems is presented. It is specifically concerned with the immediate problem of whether F-9J aircraft should be overhauled or replaced. The method used calculates present values of differential costs of four alternative retirement policies. Recommendations are made for phasing in replacement aircraft at particular rates and beginning at particular times.

IRC 24
Wilson, Jr., Desmond P., "Strategic Projections and Policy Options in the Soviet-Cuban Relationship," 13 pp., 11 Mar 1968, (Published in ORBIS Vol. XII, No. 2, Summer 1968; Reprinted in Military Review, Vol. XLIX, No. 4, Apr 1969) AD 666 819
This paper projects the Soviet-Cuban relationships by: (1) Citing 3 factors which structure it, (2) Combining Soviet foreign policy alternatives with Soviet intentions either to remain or to withdraw from Cuba to form a matrix with 4 outcomes, and (3) Analyzing each outcome for policy inferences and Soviet problems which have implications for the United States.

IRC 27
Breckner, Norman V., Hyde, Gary L., Weiher, Rodney F., and Yearick, William A., "Analysis of

IRC 27–Continued

Merchant Shipping and International Commodity Flow," 63 pp., 14 Feb 1969, AD 688 427

Part A of this research contribution describes Free World merchant ship movements during 1966. Part B is devoted to the examination of selected international commodity flows in 1964. Estimates are made of merchant ship traffic in 1975.

IRC 28

Hyde, Gary L. and Weiher, Rodney F., "Japan, the United Kingdom, and Selected European Countries: The Importance of Trade," 58 pp., 19 Feb 1969, AD 688 428

The trade of selected nations of the Free World is discussed, including the importance of this trade to domestic economies.

IRC 31

Rose, Marshall, "An Investment Model for Reparable Assets: The F-4 Case," 163 pp., Jul 1969, (Presented at the 5th Annual DoD Cost Research Symposium, Mar 1970; Published as 1969 Ph. D. dissertation in Economics, Tulane University, entitled: Development and Application of Time-Constrained Inventory Model for Reparable Assets, available from Tulane University or University Microfilms) AD 694 946

An investment model for reparable assets is developed. These assets include items such as end products (aircraft, ships, etc.) and the recoverable parts which comprise these end products. The model is applicable to firms which operate a number of end products and maintain a rework facility for periodic servicing of the end products. The problem is to find the minimum-cost combination of repair resources (equipment, labor, and spares) and end products in order to obtain a given level of available end products. The model is then applied to the case of those F-4 aircraft scheduled to be reworked at the North Island Air Rework Facility.

SECTION III

C. MARINE CORPS OPERATIONS ANALYSIS GROUP

Research Contributions

MRC 6

Mason, Thomas W. and Tullier, Pierre M., "Marine Corps Operations Analysis Group Information Retrieval System," 49 pp., 15 Jun 1966, (Presented at the 29th Annual Meeting, Operations Research Society of America) AD 640 680

An information retrieval system was developed to assist Headquarters Marine Corps (HQMC), the Marine Corps Landing Force Development Center (MCLFDC), and the Marine Corps Long Range Study Panel (LRSP). In operation of the system a large volume of classified information is scanned by MCOAG analysts and only those items pertinent to operations research on Marine Corps problems are to be included in the information file.

SECTION III

D. NAVAL WARFARE ANALYSIS GROUP

Studies

NWS 4

Higgins, J. W. and Weinberg, R. S., "The Feasibility of a Global Airlift," 23 pp., 5 Sep 1957, AD 719 899

The number of aircraft and amount of fuel needed to airlift U.S. imports and exports are determined in this study for both the full flow of U.S. overseas trade and for the more limited importation of only vital strategic materials. The study also considers an operation in which surface tankers haul the fuel for cargo aircraft to those overseas points where needed. Finally, the number of surface ships and the amount of fuel needed to sustain the same lift by sea is developed for comparison with the airlift requirements.

NWS 61

Lukes, George D., "Penetrability of Haze, Fog, Clouds and Precipitation by Radiant Energy Over the Spectral Range 0.1 Micron to 10 Centimeters," 214 pp., May 1968, AD 847 658

To determine attenuation values over a wide range of wavelengths, an analytical methodology is developed to accommodate the population of droplets according to size in unit volume of several models of water-occluded atmospheres. The extent of penetrability of cloudy and rainy atmospheres is then demonstrated analytically as a function of wavelength. The analysis of attenuation by water droplet atmospheres draws on the Mie theory of absorption and scatter by spherical droplets. Because of requirements forged by its scope, the study provides an extensive data base on the population of droplets by size in various water-occluded atmospheres.

NWS 64

Feldman, Leon, Keutman, Charles H. (LCol., USAF), Simon, Susan, and Welsh, Joyce, "Study of Land/Air Trade-Offs (SLAT), Volume VII 'Historical Data Base'," 100 pp., Apr 1970, AD 869 479

This volume contains the Korean War historical data base that supports the SLAT historical analysis. The volume provides daily summaries of combat data concerning the U.S. and Allied air and ground force effort for the several months of the war investigated by the study group. It is further intended to be a permanent historical record that may facilitate future research on the Korean War.

NWS 64

Overholt, John L., Feder, P., Keutman, Charles H. (LCol., USAF), Miller, C., Rafferty, Sheila, and Welsh, Joyce, "Study of Land/Air Trade-Offs (SLAT), Volume IX 'Statistical Analysis of Korean War Data-Spring 1951'," 110 pp., Apr 1970, AD 869 481

Battle data of divisions engaged in the Korean War during the spring of 1951 is analyzed by statistical methods for relations among strengths, firepower, and casualties. Graphs are presented covering this and other data for U.N. divisions over time.

Interim Research Memoranda

NIRM 6

Kaula, William W., "Accuracy of Orbital Predictions for Close Satellites," 13 pp., 5 Jun 1962, AD 758 423

The principal sources of orbital prediction errors are instrumental errors, neglected geodetic effects and unpredictable atmospheric variations. The geodetic effects are estimated in this paper. These include estimates of the first few terms of the expression for the earth's gravitational field, and estimates of the expected residual geodetic errors in certain broad areas of the world.

NIRM 8

Duncombe, Ralph L., "The Accuracy of Orbit Prediction on Non-cooperative Earth Satellites," 13 pp., 13 Jun 1962, AD 761 190

Two systems for tracking passive (non-cooperating) satellites are considered: the Navy Space Surveillance System (NavSpaSur) and the "Millstone" active radar. Accuracy estimates are presented for both. Future improvements to both systems and combinations of them are also considered. The effect of large solar flares on prediction accuracy is estimated.

NIRM 9

Arnold, Robert D., DePoy, Phil E., and St. Denis, Manley, "Sea-based Airborne Assault—A New Mission for the Navy," 69 pp., 29 Jun 1962, AD 761 191

A new mission for aircraft carriers is proposed. The mission is to provide mobile bases from which to operate transport aircraft capable of

NIRM 9—Continued

landing troops and equipment at inland points where a threat requiring immediate discriminating response may exist. Mission requirements are examined, and capability estimates are derived from predictable aircraft technology.

NIRM 10

St. Denis, Manley, "First-Order Estimate of the Initial Investment Cost of Conventionally Powered Strike Aircraft Carriers," 22 pp., 17 Jul 1962, AD 758 419

A method for making a first-order estimate of the initial investment cost of conventionally-powered strike aircraft carriers is presented. The only input parameters required to apply the method are: carrier displacement, year in which the ship is to be laid down, whether the ship is a new or a repeat design, and whether the ship is to be built in a naval or private shipyard. Application of this method to an illustrative example indicates a quasi-linear, but not proportional, variation of cost with displacement within the range of 40,000 to 100,000 tons.

NIRM 11

Buckley, Janet K. and DePoy, Phil E., "Dive and Glide Error Sensitivity Program and IBM 7090," 15 pp., 17 Aug 1962, AD 758 420

This memorandum describes an IBM 7090 computer program for determining values of error sensitivity for dive and glide bombing with free-fall weapons. Sensitivities of the weapon impact point to small deviations from planned release conditions are computed assuming vacuum trajectories of the weapons.

NIRM 12

DePoy, Phil E., "Usage Manual for a Computer Program to Compute the Effectiveness of Groups of Weapons Against Rectangular and Line Targets," 73 pp., 21 Aug 1962, AD 758 421

This memorandum describes an IBM computer program to compute the probability of killing a rectangular or line target with salvos, sticks, or patterns of weapons. It is considered that the weapons are delivered with a bivariate-normal aiming error and that the individual rounds are distributed around their mean points of impact within the group with bivariate-normal ballistic dispersions. The conditional kill probabilities of individual weapons are taken into account. Flow charts, a listing of the **FORTRAN** program, and sample problems are included.

NIRM 13

Karp, Arthur L. and Phipps, Thomas E., "Optimum Allocation of Effort for Deterrence," 35 pp., 20 Aug 1962, AD 758 422

Mathematical models of optimum procurement allocation among different types of retaliatory weapons systems are examined. A distinction is drawn between so-called numerically vulnerable systems (which find safety in numbers and are approximated by fixed missile bases) and percentage vulnerable systems (which require the enemy to engage in a search effort to counter them, e.g., because they are mobile). The prime value of this paper is believed to be its demonstration that even in the simplest cases cost/effectiveness comparisons may not lead to optimum solutions about allocations of resources among countermeasure susceptible weapons systems.

NIRM 18

Ravenscroft, Jr., Lincoln, "A First-Order Derivation of the Complement of a Strike Aircraft Carrier," 41 pp., 24 Sep 1963, AD 761 192

A simple first-order mathematical model is formulated for determining the complement aboard a strike aircraft carrier, using as parameters the full load displacement, the shaft horsepower, and the armament and aircraft suits.

NIRM 20

Lohman, John B., "Theory of Errors of Celestial Navigation," 27 pp., 31 Jul 1963, AD 704 108

This analysis is concerned principally with a method of eliminating the bias introduced as a result of incorrect estimates of the dip of the horizon in celestial navigation by sextant. In addition, several other considerations germane to celestial navigation and bearing pilot are treated briefly.

Research Contributions

NRC 22

Demsetz, Harold, "A Project Strike Document: A Note on Discounting in Systems Analysis," 3 pp., 31 Oct 1963, AD 757 045

The rationale for discounting in system analysis is discussed briefly and an important field of sub-optimization is pointed out where discounting procedures are inconsequential.

NRC 23

Isaacs, Rufus, "A Project Strike Document: The Probability Distribution of the Number of Targets Hit under Successive Firings," 10 pp., 31 Oct 1963, AD 757 046

NRC 23–Continued
A mathematical development is presented which answers questions concerning the probablistic outcomes of a succession of weapons (bombs) aimed at some complex of targets.

NRC 31
Dufort, R. H., "The SOS (Sentinel on Station) Interceptor/Loiter Aircraft–A Study of a Two Stage VTOL Aircraft Serving a Task Group Defense Role," 33 pp., 8 Nov 1963, AD 761 187
A discussion is presented of a two-stage VTOL aircraft capable of long loiter and very fast intercept.

NRC 32
Behrens, Carl E., "Vulnerability of Strike Forces to Submarine Attack," 10 pp., 20 Nov 1963, AD 761 189
An examination is made of the vulnerability of carriers to attacks by submarines using torpedoes or short-range missiles. A mathematical model is derived, and the interactions of several parameters are examined.

NRC 35
Dawson, William L., "Comparative Analysis of CTOL and VTOL Strike Carrier Attack Aircraft," 22 pp., 11 Dec 1963
Examines the future conventional war capabilities of CTOL (conventional take-off and landing) and VTOL (vertical take-off and landing) attack aircraft for evidence as to the orientation of effort that should be devoted to the development of these systems for sea-based strike forces in the 1970-1980 decade. A major objective is the arrangement of readily quantifiable capabilities into a numerically based analysis which can be used in conjunction with qualitative judgment to identify areas that hold promise of improved operational and cost effectiveness.

NRC 36
Linstone, Harold A., Ravenscroft, Jr., Lincoln, Saxton, J. A., and Wade, John J., "A Project Strike Document: The Vari-Purpose Carrier (CVV)," 13 pp., 12 Dec 1963, AD 757 047
This paper presents the concept of a single versatile sea-based carrier (CVV) having the capability to perform a variety of missions now carried out by three separate combat carriers: the CVA, CVS, and LPH. A first-order estimate of size, principal dimensions and cost is given, and resulting implications are discussed.

NRC 40
More, Kenneth R., "Approaches to the Study of Force Levels," 6 pp., Dec 1963, AD 760 061
A discussion of the contributions to over-all studies of force structures that must be made by continuing strategic, naval warfare systems, fleet support, personnel and logistics studies.

NRC 41
Moore, Arnold B., "Some Comments on a Proposed Nuclear-Powered Cargo Ship," 29 pp., 15 Jan 1964, AD 757 048
This paper argues that evidence presented by proponents of the high-speed nuclear system is either based on misleading cost estimates, or not suggestive of commercial benefit from the development of the proposed reactors. In either case, the argument for development of the reactors is reduced in force. Further, it is argued that no convincing case has been made for any net benefits for this country to be derived from nuclear-powered cargo carriers.

NRC 42
Riess, Michael and Westlund, George A., "An Event-Store Computer Program for Determining Sealift Capabilities and Attrition in an ASW-Environment; CNA Computer Program 58-63P: Sealift I," 253 pp., 1 Feb 1964, AD 437 301
A Monte Carlo simulation of a convoy submarine battle is presented; it is one of the event-store type and is written for the IBM 7090. The model is probabilistic: no kinematics or geometry are "wired in." Thus, there is no information or data within the model and the outcomes are made to depend wholly on data supplies as inputs. In the battle simulated, the convoy is organized in its home port, sails to its delivery port in the face of fixed barriers, submarines, and aircraft opposition, is subjected to air attack while unloading, sails home along the same route to its home port, and is disbanded.

NRC 45
Kadane, Joseph B., "An Obstacle-Course Problem: I," 15 pp., 22 May 1964 (Superseded by A 1015)

NRC 47
Denenberg, Stewart A., Emerling, Lowell, and Westlund, George A., "Logistic Feasibility Scheduling Model; Computer Program 38-64P," 47 pp., 12 Nov 1964, AD 486 534
An IBM 7090 computer program is described that simulates vehicle assignments to a priority-

NRC 47—Continued

ordered sequence of cargo units. The schedule thereby generated is used to assess the lift capability of an arbitrary vehicle inventory or to compare one vehicle inventory with another. The model can thus be used to determine the logistic feasibility of an operations plan and, if feasibility is demonstrated, indicate where logistic augmentation or modification is most desirable. Flow charts, a listing of the FORTRAN program, and sample inputs and outputs are included.

NRC 50

Berndtson, Charles R., Curran, W.,* Damico, Richard R. (LCdr., USN), Graves, James W., Riess, Michael, and Weiderkehr, Robert R. V., "An Event-Store Computer Program for Determining the Vulnerability and Logistics Requirements of CVA Strike Forces in an ASW and AAW Environment; CNA Computer Program 26-64P: CVA/Vulnerability and Logistics Model," 730 pp., 1 Feb 1965, AD 466 554

A Monte Carlo simulation of CVA Strike Forces operating in an ASW and AAW environment is presented. It is of the event-store type and is written for the IBM 7090 computer. As well as looking at vulnerability of the strike forces, the game also keeps track of three logistics quantities—NSFO, JP, and ordnance—for each strike force plus the URG.

United Aircraft.

NRC 51

Goldman, Thomas A., "Decentralized Maintenance," 8 pp., 12 Apr 1964, AD 704 102

In a large military or industrial organization, in which equipment is operated at a number of field locations, maintenance may be performed at the individual field sites or at a central location, or maintenance resources may be divided between a central location and the field sites. The problem of choosing an optimal balance between centralized and decentralized maintenance then arises. This paper examines the application of queueing theory to this problem.

NRC 57

Levine, Daniel B., "Description of Computer Program; 'NAVWAG 251'," 18 pp., 24 Feb 1966, AD 829 467

A simplistic computer model for calculating the number of target kills developed by a number of Navy and Air Force aircraft during a 30-day campaign is described. Daily sortie rates, kills per sortie, attrition rates, CVA cycling, and force augmentation and replacement are inputted by aircraft type, from which the model calculates the build-up in time of total number of sorties, target kills, and attrition of the Navy and Air Force aircraft during the campaign.

NRC 62

Emerling, Lowell and Sprengelmeyer, Laura, "Vertical Assault Lift Simulation Model; CNA Computer Program 18-65P," 62 pp., 21 Apr 1966, AD 829 468

A CDC 3400 program is described which simulates the vertical assault lift operation during the initial period of an amphibious operation. The model was designed to be used as an aid in comparing the capabilities in this area of different types of ships, types of helicopters, and helicopter mixes. Flow charts, a listing of the FORTRAN program, and a sample problem are included.

NRC 63

Fain, Janice B., "Tactical Warfare Simulation Program, II (TWSP-II)," 193 pp., 18 Aug 1967, AD 829 421

The "Tactical Warfare Simulation Program, II" (or TWSP-II) is composed of 2 parts: (1) the model—a set of definitions and ground rules which make up a model of tactical ground warfare, and (2) the program—a set of computer instructions which calculates the results of a planned conflict according to the rules of the model. Included in the appendixes are the data input forms, the input and output for a small test case, and the FORTRAN listing of the program.

NRC 64

Fain, Janice B., "DPEN Subroutine," 13 pp., 21 Aug 1967, AD 829 420

The DPEN subroutine determines if (and where) a specified segment of a straight line intersects a rectangle. DPEN is written in FORTRAN IV and occupies 158 48-bit words. Since all information required and all numbers calculated are carried in the calling sequence, DPEN may be used in any program.

NRC 83

Kalman, Peter J., "A Stochastic Constrainted Optimal Replacement Model for a Set of Ships," 38 pp., 8 Nov 1968, AD 684 819

In this paper a stochastically constrained replacement model is formulated. This model determines a sequence of replacement dates such that the total "current account" cost of all future costs and capital expenditures over an infinite time horizon for the n initial incumbent ships is minimized subject to the constraints that a certain

NRC 83–Continued

number of ships are in a chosen military worth class at any point in time. The theoretical model was then solved for a specified set of assumptions.

SECTION III

E. OPERATIONS EVALUATION GROUP

Reports

OER 51

Sternhell, Charles M. and Thorndike, Alan M., "Antisubmarine Warfare in World War II," 331 pp., 10 Apr 1946, AD 221 292

Part 1: History of Antisubmarine Operations

An account of the various stages in the evolution of the U-boat: convoys, the use of aircraft, and scientific and technical devices. Contains comprehensive tables and charts of shipping losses and U-boat sinkings.

Part 2: Antisubmarine Measures and Their Effectiveness

A summary treatise dealing with antisubmarine measures from a quantitative point of view. The discussions are based on analyses of operational data in the light of basic theory. Subjects dealt with are: safety of independent shipping compared with convoys, attacks by surface craft and aircraft, offensive search, employment of search radar, and countermeasures to the German acoustic torpedo.

OER 54

Kimball, George E. and Morse, Philip M., "Methods of Operations Research," 320 pp., 7 May 1946, AD 200 782

A comprehensive treatise on the subject of operations evaluation, with special reference to military problems. The requisite mathematical basis for such research is developed and applied to the methods of obtaining measures of effectiveness in evaluating diverse military operations. Strategical kinematics, tactical analysis, gunnery and bombardment problems, and operational experiments with equipment and tactics are given particular consideration. A chapter is devoted to the organizational and procedural problems of an operations research group.

OER 56

Koopman, Bernard O., "Search and Screening," 343 pp., 20 Feb 1947, AD 214 252

In every question of search there are in principle two parts. One involves the targets, and studies their physical characteristics, position, and motion; and since the latter are largely unknown to the searcher, a branch of the science of probability is applied. The other part involves the searcher, his capabilities, position, and motion, including a study of the probability laws of

detection. Applications are made to the tactical matters in which search is an essential component, such as hunts, barriers, and those defensive types of search known as screens. The book is not a manual of practical information for naval officers, but is intended to serve as a theoretical framework and foundation for more immediately practical studies and recommendations.

OER 59

Koopman, Bernard O., "Probabilities in a Sequence of Correlated Events," 75 pp., 20 Apr 1949, AD 807 345

The correlation between shots is treated by regarding them as repeated dependent trails, the probability of a hit being determined by the success or failure of the previous shot. Relevant results on Markoff chains are summarized and extended to the case of non-stationary correlation. The system of difference equations is made the basis of the treatment, which provides an IBM computational scheme for finding the probabilities of various numbers of hits, and also explicit formulas for such probabilities in a case which generalized the Poisson distribution. Illustrative applications are given to gunnery data.

Studies

OES 250

"Vision in Air Sea Rescue Search," 14 pp., 18 Jan 1946, AD 895 142

Analysis of operational data in the light of theoretical considerations of search. Ranges at which various targets can be seen under different conditions of sun, sea, cloud, and haze and probabilities that these targets will be seen. Results provide information on which to base number and sector assignments of lookouts, scanning procedure to be employed and force requirements for a given search task.

OES 281

Lamar, Edward S., Mintzer, D., and Rinehart, R. F., with addendum by Fine, N. J., "Scouting and Search by Surface Force," 49 pp., 22 Aug 1946, AD 719 429

Principles of scouting and search by surface forces. Includes definitions, primary search factors, methods of search and selection of methods or means of search. The addendum amplifies the study by including worked-out examples for the various types of scouting which are described.

OES 297
Kimball, George E., "The Ideal Search Theorem," 4 pp., Oct 1946, AD A006 824

This study furnishes a method for finding the optimum effectiveness which could be obtained if the ideal search plan were used to search any given area. When the optimum effectiveness which could be obtained is known, one knows when a trial plan is constructed how it compares in probability of contact with the ideal plan for that area.

OES 368
Lamar, Edward S. and Goldstein, Leon, "Visual Detection in Air Interception," 53 pp., 26 Oct 1948, AD 224 089

This study concerns the probability that a single fighter aircraft will make visual contact on a single target aircraft under daylight conditions of illumination. Quantitative results are presented which permit the computation of the probability of sighting by any given range as a function of each of a number of parameters. Some typical examples are worked out in detail showing the effects of such parameters as relative speed, angle of view, uncertainty in azimuth and in elevation.

OES 430
Marcuse, Elaine, "Computation of Probability of Visual Detection in Air Interception," 13 pp., Nov 1950 (Appendum to OEG Study 368, "Visual Detection in Air Interception")

This study presents a method and associated working graphs which enable one to calculate the probability of visual detection of a target aircraft by an airborne observer, under daylight conditions of illumination, for a wide range of the parameters involved.

OES 467
Bingham, Origen K., "Damage Suffered by USN and USMC Ground Attack Aircraft in Korea," 19 pp., 4 Feb 1952, AD 841 042

The kind of information that can be obtained from analysis of Aircraft Vulnerability Report Forms is described, and the results of a preliminary study, made to determine the value of a larger-scale analysis, are reported. The study concludes that: (1) although hits from ground fire are uniformly distributed over both jet and conventional aircraft, the jets received a greater proportion from ahead and directly below; (2) in terms of aircraft lost per hit, the F-4U is twice as vulnerable as the F-9F, which is in turn twice as vulnerable as the AD; (3) the variation in vulnerability among aircraft can be markedly affected by design.

OES 470
Engel, Joseph H., "Visual Detection in Air Interception: A Comparison of Theory with Trial Results," 51 pp., 15 Aug 1952, AD 224 410

Probabilities of detecting airplanes visually in daylight have been determined in trials conducted by the Naval Air Test Center, Patuxent River, Maryland. Comparison of the results with those predicted by visual-detection theory (OES 368) indicates that the theory adequately describes visual detection in air interception. The agreement between trial results and theory is better when the actual cross-sectional areas of the targets are used in computing maximum ranges of detection than it is when the assumption is made tthat these ranges are proportional to the cube roots of the gross aircraft weights.

OES 506
Brooks, Douglas L. and Karns, Charles W., "Characteristics of Naval Gunfire Support in Korea," 49 pp., 11 Jun 1953, AD 756 950

The purpose of this study is to summarize the descriptive statistics which characterize the utilization of Naval gunfire in Korea and which are of historical interest, and to show that the requirements for reliable analysis of the factors influencing economy and effectiveness are not met by the present combat data collection program which relies solely on subjective and uncertain visual observation of results.

OES 533
Behrens, Carl E., "Effects on U-Boat Performance of Intelligence from Decryption of Allied Communication," 24 pp., 28 Apr 1954

Examination of the War Diary of the German ComSubs has made it possible to estimate the character and extent of intelligence obtained by the decryption of Allied radio messages pertaining to convoy operations in the North Atlantic during World War II, and to determine the effect of such ships. It is estimated that the availability of timely useable decryption intelligence increased the contact rate two-fold over that which they would have obtained without it; probably over 60 sinkings in excess of the expected number if they had been deprived of decryption intelligence.

OES 624
Smith, Robert P., "The Use of Binoculars in the Search for Submarines at Sea," 21 pp., 13 Oct 1959, (Presented at Visual Search Techniques Symposium, Apr 1959) AD 703 933

Although the modern snorkel submarine spends much less time on the surface than its predecessors, it still presents a visible surface target during the snorkel phase of its operation. This study considers the value of binoculars as an aid to airborne visual search for snorkeling submarines. Also, the problems of search for friendly or inert targets and of optimum employment of multiple lookouts are discussed.

OES 626
Dobbie, Joseph M., "Probability of Damage Problems of Frequent Occurrence," 25 pp., 11 Dec 1959, AD 816 397

This study summarizes some of the salient methodology which has been developed for the solution of problems involving the computation of the probability of damage to military targets. The problem of computing the probability of killing the target, or of inflicting a stated degree of damage, by a single shot or a salvo is considered.

OES 644A
Kent, Clem F., "Echo Variability and the Formulation of a Radar Theory," 35 pp., 17 Aug 1962, AD 286 670

Basic considerations important to the fabrication of a mathematical model of operational radar performance are given. Experimental evidence gathered at 425 MC is used to show the presence of substantial long-term undulations in the mean returned signal from a target at constant range. The implications of these undulations are reviewed, and experimental investigation of their sources is strongly recommended.

OES 665A
Haering, George, "Evaluating Future Tactical Air Weapon Systems," 20 pp., 26 Apr 1963, AD 729 421

Methods of evaluating future offensive air weapon systems for non-nuclear war are discussed. New criteria which avoid many of the weaknesses inherent in previous approaches are proposed. Some of the implications of improved air defenses and various types of basing are surveyed.

OES 684
Dietz, Steve K., "Ballistic Dispersion of Mk80 Series Bombs Delivered in Sticks by A-4 Aircraft," 21 pp., Dec 1974, AD 356 868

The ballistic dispersion of low-drag bombs dropped in sticks from the A-4 aircraft is calculated from test data. The data are inadequate to permit determination of whether dispersion depends on slant range or time of fall, but an estimate can be made for delivery parameters of interest.

OES 688
Heselton, Leslie R., Jr., "The Effectiveness of A-1 Bombing Attacks on Bridges," 30 pp., 28 Apr 1965, AD 362 078

This study determines the effectiveness of various A-1 aircraft payloads against bridges. The optimum load, regardless of bridge type, consists of 8 Mk-82 (500-pound) bombs, plus additional ordnance as permitted by radius loading time, and weight considerations. Effects of different intervalometer settings and approach angles are also analyzed: effectiveness is reduced if long intervalometer settings are used, but is insensitive to approach angle if the optimum setting is used. Data for adjusting effectiveness estimates to reflect variations in bridge size and delivery accuracy are also provided.

OES 696
Bobotek, Henry G., "The Use of Search Memories in Automatic Tracking," 59 pp., 14 Oct 1965, AD 623 090

The use of a search memory for correlation in automatic tracking in track-while-scan systems is examined. Several memories (some previously proposed by the industry and some suggested here) are compared and the types suitable for single- and multi-attempt correlation are identified. An inherent requirement for frequent changing of stored information makes some memories undesirable, and the impact of this requirement should be carefully examined whenever an application of search memory is considered.

OES 706
Nerenstone, M. A. and Culbertson, D. D., "Market Time, Countering Sea-Borne Infiltration in South Vietnam," 100 pp., 20 Dec 1966, AD 378 336L

This study presents data and analyses relevant to Market Time operations as of the early spring of

OES 706 — Continued

1966. Estimates of the infiltration rate and their significance are discussed. Barrier design and effectiveness estimates are considered.

OES 741

Timenes, Nicolai, Jr., "An Analytical History of Kamikaze Attacks Against Ships of the United States Navy During World War II," 108 pp., 18 Feb 1971, AD 725 163

This volume begins with a history of the early encounters between Japanese and American carrier aircraft and shows how the patterns of aircraft losses by both sides changed during the war. The effect on Japan of losing aircraft, pilots, aircraft carriers, and other resources is discussed as a background to the decision to employ the kamikaze tactic. Then the history of the employment of the kamikaze is discussed in terms of 2 major campaigns—the Philippines and Okinawa. Finally, statistics on results in the Philippine and Okinawan campaigns are used to establish estimates of the effectiveness of defense at various stages—attack at the source, defense by interceptors, defense by anti-aircraft guns, and the like.

Interim Research Memoranda

OIRM 3

Titchen, Robert S., "Catalog of Naval Capabilities Pertinent to Cold War and Limited War," 6 pp., 15 Nov 1961, AD 757 033

This research contribution lists the general capabilities of the U.S. Navy to perform missions in cold war and certain kinds of limited war. This listing has been prepared because of the recent interest in national ability to provide graduated responses short of nuclear war.

OIRM 4

Willis, Kenneth E., "Usage Manual for MOD I SAM Anti-Air Simulation Program for IBM 7090," 14 pp., 8 Dec 1961, AD 272 879

This program computes the maximum possible number of intercepts that a particular surface-to-air missile system can achieve against a particular point or stream air raid when the points of initial radar acquisition, the last allowable intercept, and the parameters to describe the systems are given. Instructions are given for using the program, and a brief explanation of the mechanics of the simulation is presented.

OIRM 5

Tyson, James K., "Theory of Sortie Rates," 58 pp., 22 Jan 1962, AD 275 498

This study is concerned with the mathematical analysis of sortie rates as an example of a general repetitive process, involving the use of equipments which are subject to random requirements for repair or replacement.

OIRM 6

Randall, Royal W., "A Game Theoretic Model of Submarine Barrier to Detect Transitor Submarines," 21 pp., 17 Jan 1962, AD 280 114

A barrier submarine/transitor submarine conflict is formulated and solved as a 2-person game. When described as a game, the conflict becomes a problem of obtaining distributions along the barrier of the locations of (1) transit lanes, and (2) locations of the barrier submarine, for which a game-theoretic optimum probability of detection is to be obtained.

OIRM 7

Kent, Clem F., "Processing Detection Data Gathered from Targets of Opportunity," 5 pp., 29 Dec 1961, AD 857 271

The consequences of the so-called definite-range assumption are explored, and a simple formula is derived for converting detection ranges to an estimate of true distribution of detection range, lateral-pass probability of detection, or direct-approach detection probability.

OIRM 8

Karns, Charles W. and Randall, Royal W., "A Queueing Description of a One Priority, Single-Channel Communication System with Outages," 14 pp., 27 Dec 1961, AD 279 159

A limited theoretical investigation is made of the effects of interferences in a communications system on the number of messages awaiting transmission and on the average time the messages must wait for transmission. Since the study is theoretical, tests are necessary to determine the validity of the assumptions.

OIRM 10

Arnold, Robert D., "Avoidance in One Dimension: A Continuous-Matrix Game," 14 pp., 11 Jan 1962, AD 277 843

A 2-person, zero-sum game is described. On each play, each player selects any point on a line of finite length. The payoff is a trapezoidal function of the separation between the 2 selected points;

OIRM 10

it is constant for separations from zero to R1, changes linearly between R1 and R2, and is zero for separations greater than R2. The derivation and proof of the solution are interesting due to discontinuities in the slope of the payoff function. The game is related to search theory in its applicability to the barrier problem.

OIRM 13

Bram, Joseph, "Two Games Arising in the Optimal Allocation of Resources," 17 pp., May 1962, AD 757 031

A mathematical analysis is given of two types of games which arise in a model of deterrent forces surviving an enemy first strike.

OIRM 15

Miller, R. H., "Status of V/STOL Technology," 17 pp., 23 Apr 1962, AD 275 507

A considerable amount of development work has gone into such configurations as the compound helicopter, the tilt wing, and various high-bypass-ratio engine concepts or ducted fans. For military missions requiring appreciable hover time these configurations are of interest. With the requirement for supersonic speeds for missions, the jet VTOL becomes increasingly feasible at no increase in weight.

OIRM 18

Hammerle, John F., Howe, Steven H., and Mason, R. D. "Model and Computer Program for an Attack on an Evading Submarine," 33 pp., 8 Jun 1962, AD 277 831

A model and computer program for computing kill probabilities for an attack on an evading submarine is discussed. Various tactical situations and delivery methods can be treated by the model, which has available a wide range of parameters.

OIRM 21

Bram, Joseph, "Minimizing the Approach Time of an SSK to its Target," 10 pp., 13 Aug 1962, AD 284 796

A tactical problem and solutions are presented. The tactical problem seems on first sight to be an ordinary calculus of variations problem, but the integral that gives the time to traverse a path contains the (variable) time in the integrand. This makes the Euler equations inconsistent, and a modification of the usual procedure is needed to obtain the time variation.

OIRM 22

Bram, Joseph, "A Lanchester-Type Model for

Combat Between Submarines, Carrier Task Groups, and HUK Groups," 24 pp., 28 Aug 1962, AD 290 921

The application of a Lanchester combat mathematical model to a case in which 2 naval forces are engaging a large ocean arena is explored. Specifically, carriers protected by ASW screens are in the area attempting to accomplish a mission supported by HUK groups that roam the area, hunting submarines. The carriers are opposed by submarines that must seek and attack the carriers. The approximation reported is substantially better than earlier efforts, particularly in certain critical cases.

OIRM 23

Weiderkehr, Robert R. V., "The Behavior of a Single-Channel Queue with Periodic Exponentially Distributed Interarrival Times and Service Times," 72 pp., 17 Sep 1962, AD 288 128

A mathematical model is developed for a simple queueing system, a single-channel queue with exponential and periodically varying interarrival and service-time distributions. It appears that these queueing systems should prove useful in simulating parts of the Naval Communications System and in predicting possible improvements in its operations.

OIRM 24

Budnitz, Robert J., "A Method for the Theoretical Determination of the Radar Cross-Section of Aircraft," 14 pp., 24 Sep 1962, AD 288 677

A modification of the method developed at the Radiation Laboratory of the University of Michigan for the theoretical calculation of the radar cross-section of aircraft is suggested.

OIRM 25

Howe, Steven H. and McCree, P. W., "Model and Computer Program for Calculating the Kill Probabilities for Certain ASW Tactics," (Superseded by ORC 47) AD 402 265

OIRM 28

Hubbard, Robert L., "FORTRAN Program to Estimate Cumulative Survival Probability and Variance," 13 pp., 31 Oct 1962, AD 293 155

This computer program has been devised to examine the survival times of test elements to estimate survival probability as a function of time. Input quantities consist of (1) ages of elements at start of test, (2) ages of elements at times of failure, and (3) ages of elements when withdrawn from test prior to failure. The principal output quantities are (1) the expected value

OIRM 28 – Continued

of survival probability at the age associated with each observed failure, and (2) the variance and standard deviation associated with each probability estimate. The use of elements from truncated tests serves to take advantage of the largest possible sample size for a given time period without introducing a biased survivability estimate.

OIRM 29

Haering, George, "The Impact of Attrition on Sustained Offensive Air Operations," 20 pp., 5 Nov 1962, AD 293 147

Data from World War II and Korea is used to show that commanders have accepted 5 percent average aircraft attrition for prolonged periods. Attrition of 20-25 percent suffered in a short period has caused the abandonment or modification of sustained air operations. The acceptability of attrition rates between these two levels seems to depend on factors other than the actual loss rate itself.

OIRM 31

Bram, Joseph, "A 2-Player N-Region Search Game," 21 pp., 17 Jan 1963, AD 402 914

Given N regions with their associated conditional detection probabilities, let player A choose one region to hide in, and let player B look in one region at a time until he finds A. The payoff, to player A, is the expected number of looks required of B to find A. The form of the optimal pure strategies for B is described, and the mixed extension of this game is shown to have a solution. Player B has a good strategy that is a mixture of at most N pure strategies. A numerical procedure for calculating the solution is given.

OIRM 32

Bram, Joseph, "Allocation of Weapons to Targets with Exponential Arrival Times in a Limited Time Interval," 9 pp., 16 Jan 1963, AD 401 357

Given a supply of weapons and a time in which to operate, what is the best way to allocate the weapons among the incoming targets arriving with an average rate so as to maximize the expected number of targets killed? This problem leads to a system of ordinary differential equations which can be solved recursively, and whose solutions furnish the values of the expected number of targets killed, as well as the optimal firing schedule.

OIRM 35

Engel, Joseph H., "Combat Effectiveness of Allied and German Troops in the World War II Invasion of Crete," 12 pp., 8 Feb 1963, AD 298 786

An analysis is made of statistics pertaining to the landing of German troops, and landing or withdrawal of British and Allied troops during the invasion of Crete by the Germans in World War II, using information on total casualties experienced on each side and the assumption that Lanchester's Law holds. The combat effectiveness of the average individual troops on each side are computed and compared with similar figures for the battle of Iwo Jima.

OIRM 36

Goldman, Thomas A., "Bayesian Supply Policies for Service-Life Parts," 15 pp., 27 Mar 1963, AD 405 106

The characteristic feature of service-life parts, from the standpoint of inventory theory in particular and of logistics management in general, is that demands are not generated by a Poisson process, because failures are not independent of age. The applicable statistical models are those of renewal theory and replacement theory. Where uncertainty exists concerning the parameters of the underlying failure distribution, techniques of Bayesian decision theory may be advantageously applied. Some theoretical and practical implications of applying Bayesian techniques to the logistics of service-life parts are examined.

OIRM 37

Linnell, Richard D., "Estimation of Takeoff Ground-Run Distances for Jet-Propelled Conventional and STOL Aircraft," 15 pp., 19 Apr 1963, AD 408 661

This research contribution presents methods for estimating the takeoff ground-run distances for two types of aircraft which use turbojet or turbofan propulsion systems: conventional takeoff and landing (CTOL) and short takeoff and landing (STOL). Such aircraft are defined here as having fixed-direction thrust. The maximum lift coefficient for the landing and takeoff configuration is moderate (around 1.5) for CTOL aircraft but is relatively large (around 3.0) for STOL aircraft. Both types of aircraft can be studied at one time by use of the maximum lift coefficient as a parameter for analysis of takeoff and landing distances. Only the ground-run phase of the takeoff is analyzed here.

OIRM 39

Bram, Joseph, "Minimax Prediction and an Evasion Game," 43 pp., 6 Jun 1963, AD 415 434

The problem of determining how an evading target should maneuver to survive a lethal weapon, and reciprocally, how the attacker or marksman should aim and when he should fire, is, in its general form, much too complex for a satisfactory solution. An idealized version of the problem is formulated here and solved as a 2-person zero-sum game. The game is shown to have a saddle point with pure strategies. The evader moves in one dimension and is constrained to choose from a class of Gaussian processes. The marksman uses linear prediction theory, observing the complete past history of the evader's motion.

OIRM 40

Kitchen, E. S. and Sanjour, William, "Runway Cutting III; Computer Program 2-63P," 27 pp., Jun 1963, AD 421 052

This memorandum describes a program for the IBM 7090 computer, which answers the question: "What is the expected number of passes needed to cut a runway?" The cutting is done with a group of weapons placed in a pattern with a bivariate-normal aiming error. Each weapon is distributed about its aim point with a bivariate-normal ballistic error. Cumulative bomb damage and conditional kill probabilities of individual weapons are taken into account. Flow charts, a listing of the FORTRAN program, and a sample problem are included.

OIRM 41

Engel, Joseph H., "A Model for Estimating Tracking Effectiveness," 27 pp., 8 Jul 1963, AD 416 147

A model for estimating the tracking effectiveness of a surveillance force is postulated and its equations solved. Use of the model to determine the effectiveness of a surveillance system is demonstrated, with specific numerical illustrations being provided, for the "one-target" and "many-target" cases. The use of such surveillance systems as devices to aid in "raid-recognition" is discussed briefly.

OIRM 43

DePoy, Phil E. and Sanjour, William, "Air-to-Ground Gunnery Simulation: OEG Computer Program 18-63P," 34 pp., 5 Aug 1963, AD 814 249

A usage manual is presented for an IBM 7090 computer program that uses a Monte Carlo simulation to determine the probability of destroying a rectangular target with air-to-ground gunnery. The effect of correlation of successive aim points is considered. It is assumed that the aim point is distributed with a bivariate-normal aiming error and that the individual rounds are distributed with an independent bivariate-normal ballistic dispersion. A flow chart, a listing of the FORTRAN program, and a sample problem are included.

OIRM 44

Kadane, Joseph B., "The Controversy over Counterforce," 18 pp., 12 Aug 1963, AD 757 032

This memorandum compares the arguments of an important proponent of counterforce, Herman Kahn, and one of its leading critics, Michael Brower. After examining the various arguments, the memorandum concludes that neither total counterforce nor no counterforce is the best policy, but rather some intermediate quantity of counterforce. Therefore it attacks the "counterforce" vs. "minimum deterrence" dichotomy.

OIRM 45

DePoy, Phil E., Smith, Robert L., and Westlund, George A., "Complex Target Coverage; OEG Computer Program 13-63P," 40 pp., 7 Aug 1963, AD 434 054

A usage manual for an IBM 7090 computer program is presented. The program employs a Monte Carlo simulation to determine the probability of destroying individual point targets within a target complex with one or more groups of weapons. It is assumed that the groups are delivered with a bivariate-normal aiming error and that the individual weapons are distributed with an independent bivariate-normal ballistic dispersion. The program is designed for conditional damage data for fragmentation generated by an IBM 7090 program furnished by the U.S. Naval Ordnance Test Station (NOTS), China Lake. A flow chart, a listing of the FORTRAN program, and a sample problem are included.

Research Contributions

ORC 46

DePoy, Phil E. and Westlund, George A., "Weapon Pattern Effectiveness I; OEG Computer Program 17-63P," 16 pp., 1 Oct 1963, (Superseded by CRC 129) AD 703 485

ORC 47

Adams, Robert R., Howe, Steven H., and McCree, P. W., "Model and Computer Program for Calculating the Kill Probabilities for Certain ASW Tactics," 21 pp., Oct 1963, AD 424 761

This research contribution describes a model and computer program designed to compute kill probabilities for certain firing tactics waged against an evading submarine. The model was developed assuming that the attack is imminent and that the weapon will be directed at the point where the submarine was last contacted. The model's design is centered around a determination of sets of points which represent the locus of the evading submarine. The locus is determined by variation of a simple evasion tactic. The aimpoint is considered to be circularly, normally distributed about the true position of the submarine at the time of last contact.

ORC 50

Buckley, Janet K. and Marbury, Fendall, "Computer Program 48-62P, For Assessing the Adequacy of a Schedule for Training or Otherwise Procuring Qualified Personnel," 28 pp., 21 Jan 1964, AD 434 818

Computer Program 48-62P is described, and instructions are given for its use. Its purpose is to estimate for future years the supply of personnel having some distinguishing qualification as a function of their seniority and to compare the supply with expected future needs, which can also be specified by seniority. Inputs include the initial inventory of qualified personnel, the number added for each future year for each seniority level, the expected rates of attrition as a function of seniority, and the number which will be required for each future year. Outputs include the expected future numbers of qualified personnel by seniority and the surpluses and shortages of the expected numbers over those that will be required.

ORC 51

Berndtson, Charles R. and Dietz, Steve K., "Computer Program for Calculation of Vacuum Trajectory Parameters," 26 pp., 18 Feb 1964, AD 435 625

A computer program for calculating vacuum trajectory parameters is described. Given release altitude, speed, and dive angle, the program permits the derivation of impact angle, time of fall, down-range travel, and harp angle.

ORC 52

Fry, John N., "Carrier-Based Aircraft and Repair Capacity Trade-offs: An Empirical Approximation," 22 pp., 18 Mar 1964, AD 757 027

A crude model of the sortie capacity of a carrier-based attack squadron as a function of the number of aircraft and the number of maintenance personnel is developed. Fleet data for A4B squadrons is used to derive values for the model constants by multiple regression techniques. Variation of model parameters is employed to derive an approximation of a trade-off curve for numbers of aircraft and quantity of "repair capacity" for a carrier-based A4B squadron. Some additional trade-offs implicit in the model are exhibited.

ORC 55

Dietz, Steve K., "An Analytical Method for Determining Kill Probability Against Multi-Compartmented Targets," 11 pp., Sep 1964, AD 703 486

Analytical methods are developed to determine the probability of killing a target when accumulated damage is important. A Markov chain model is used to characterize the damage status. The Markov states are cumulative numbers of exploding hits on the target, and the transitional probabilities are probabilities of n exploding hits in a shot (n=0, 1, 2, ... N). When groups of weapons are fired in a shot, the probabilities of 0, 1, 2, ... etc., hits may be obtained from an existing Monte Carlo program. Probabilities of hits are transformed into probabilities of exploding hits using the weapon reliability. With a table of conditional kill probabilities, the probability of killing the target in m shots is calculated.

ORC 56

Spitz, Hillel, "Estimating Cumulative Probability from Aggregated Truncated Data," 19 pp., 6 Jul 1964, (Published in Proceedings of Tripartite ASW Conference, Jun 1965) AD 447 677

Cumulative survival, failure, or detection probabilities cannot generally be precisely estimated from truncated samples if only data grouped in successive time intervals is available. Mathematical models of failure rate and abort rate within time are postulated from which estimates may be obtained from grouped data when the models are valid. An easily calculated approximation formula can be used in the earlier time

ORC 56 – Continued

intervals where the sample size is relatively large. This can provide data for verifying or rejecting a given model prior to making calculations in later intervals where the smaller sample size would otherwise diminish the reliability of the resulting probabilities.

ORC 58

Timenes, Jr., Nicolai, "The Firepower of a Surface-to-Air Missile System Against Crossing Raids," 13 pp., 30 Jul 1964, AD 450 163

Previously published graphic and algebraic methods of computing the maximum number of salvos a surface-to-air missile (SAM) battery can fire against a crossing raid are reviewed. Examination of the nature of an algebraic approximation shows that difficulties arise when considering targets that reach their bomb release point after the point of closest approach to the SAM battery or which have low velocity with respect to SAM velocity. An alternative graphic method of solution is suggested, which facilitates locating intercept points when investigating an engagement between a multi-channel SAM battery and a multiple-target raid.

ORC 59

Weingarten, Harry, "Gambler's Ruin and Sequential Analysis," 15 pp., 7 Aug 1964, AD 757 028

A straightforward algebraic approach successfully demonstrates that the solutions to the classical "gambler's ruin" (also known as random walk on a straight line), and a suitable stated version of the sequential analysis testing of a hypothesis, are identical. That is gambler's ruin and sequential analysis are essentially the same, from the point of view of the probability problem which is solved.

ORC 60

Denenberg, Stewart A. and Hershaft, Alex, "Antisubmarine Attack: Computer Program 13-64P," 41 pp., 28 Aug 1964, AD 757 029

An IBM 7090 computer program is described which calculates the distribution of distances between the point of activation of a weapon and a moving target submarine taking into account the estimated component attack errors. The model used is more flexible and realistic than similar past efforts and is expected to produce more reliable submarine kill probabilities. The miss distances are computed by Monte Carlo

simulation of the actual tracking and firing tactics. They are plotted by a SC 4020 plotter, first in ascending order, then as a cumulative frequency distribution. Flow charts, a listing of the FORTRAN program, and a sample calculation are included.

ORC 61

Spitz, Hillel, "FORTRAN Program for Computing Surface-to-Air Missile Firepower Against a Target that Approaches, Makes a Half-Circle Turn, and Retreats; (OEG Computer Program 37-64P)," 30 pp., 30 Oct 1964, AD 457 188

An IBM 7090 computer program is described that calculates possible intercepts from one surface-to-air missile launcher. Firing of each salvo is held until predicted intercept, based on target present position and velocity, is within maximum and minimum range limits. Successive salvoes may be launched as soon as loaded and when a guidance channel is available, or they may be held until evaluation of earlier salvoes after any predetermined initial number. Output includes time, target position, velocity components, and target angle at launch and intercept of each salvo, and also the time left after intercept before impact of a fixed-speed weapon fired at the missile launcher site by the aircraft prior to or during its turn. The program may also be used to calculate firepower against a target on a straight line path with preselected distance of closest approach to the SAM launching site.

ORC 65

Muir, Donald E., "An Analytical Method of Determining Satellite Locations for Elliptic Orbits," 20 pp., 1 Feb 1965, AD 474 618

A solution to the problem of determining the location of the ground track of a satellite traveling in an elliptic orbit is given. The approach assumes a satellite of negligible mass moving about a homogeneous earth without atmosphere. Perturbing effects caused by earth oblateness are accounted for. Steps required for the solution are (1) the initial orbital elements are derived from burnout conditions; (2) the location of the longitude of the nodes preceding and following the desired location are determined; (3) the location of the satellite track is then determined by relating the position of the actual satellite to the position of a hypothetical satellite in a circular orbit of equal period.

ORC 66
Hartley, Sarah T. and Koehn, U., "Computer Program for Fitting a Weibull Distribution to Communications Delays," 39 pp., 3 Mar 1965, AD 474 378
A curve-fitting program for the IBM 7090 is presented. The program fits a Weibull cumulative distribution function to a set of communication delay data. The parameters are determined and an indication of goodness of fit is given by the program. Flow charts, coding, and a sample problem are included.

ORC 68
Denenberg, Stewart A., DePoy, Phil E., Ridings, Richard V., Smith, Robert L., and Westlund, George A., "Complex Target Coverage; OEG Computer Program 13-63P," 50 pp., 26 Mar 1965, AD 468 847
This research contribution presents a usage manual for an IBM 7090 computer program. The program employs a Monte Carlo simulation to determine the probability of destroying individual point targets within a target complex with one or more groups of weapons. It is assumed that the groups are delivered with a bivariate-normal aiming error and that the individual weapons are distributed with an independent bivariate-normal ballistic dispersion. The program is designed for conditional damage data for fragmentation generated by an IBM 7090 program furnished by the U.S. Naval Ordnance Test Station (NOTS), China Lake. A flow chart, a listing of the FORTRAN program and a sample problem are included.

ORC 69
Hershaft, Alex, "Effectiveness of Imperfect Decoys," 9 pp., 3 Sep 1965, (Published in ORSA Journal Vol. 16, No. 1, Jan-Feb 1968) AD 627 680
Mathematical relations are developed to express the effectiveness of decoys in a situation that requires the attacker to assign his weapons on the basis of imperfect classification of the targets. The analysis considers the effects of some pertinent parameters, such as the number of real and decoy targets and the enemy's classification ability and missile effectiveness, and calculates the probabilities of survival of real targets. A number of hypothetical examples are given to illustrate the application of the theory to practical problems.

ORC 72
Lakin, W. D., "Runway Cutting IV; OEG Computer Program 17-65P," 32 pp., 4 Apr 1966, AD 481 258

A CDC 3400 computer program is described that uses a Monte Carlo simulation to compute the expected number of passes required to cut a runway with a pattern of weapons. It is assumed that the weapons are delivered with a bivariate-normal aiming error and that individual rounds are distributed with bivariate-normal ballistic dispersion. On each iteration, bomb damage is considered to be cumulative. Crater sizes and reliabilities of individual weapons are taken into account. Flow charts, a listing of the FORTRAN program, and a sample problem are included.

ORC 73
Cook, Charles M., "Crossover Barrier Penetration Program," 19 pp., 8 Apr 1966, AD 482 883
A computer program written in FORTRAN is described. This program allows calculation of the probability that a target transiting a symmetric crossover barrier will be detected. Flow charts and a listing of the program are included.

ORC 74
Dost, Helmut E., "GRANTAPE; Computer Subroutine 22-66S," 9 pp., 24 Oct 1966, AD 757 030
The routine, GRANTAPE, is a simple, but flexible, computer program allowing rapid sequential retrieval of a large quantity of numbers stored on magnetic tape. It has been used to avoid generating new Gaussain-distributed random numbers during computations in which correlations, resulting from the use of the same set of numbers for successive computations, are immaterial.

ORC 76
Nunn, Walter R., "The Lagrange Multiplier—A Heuristic Presentation," 32 pp., 31 Oct 1966, AD 643 740
Many problems in operations research require the maximization or minimization of a suitable payoff function subject to various constraints. Lagrange multipliers are classically used for this type of problem. The treatment given this technique by most texts, however, requires that the payoff and constraint functions be at least differentiable at the extremizing point. This paper shows that the Lagrange multiplier concept can be independent of differentiability or even continuity of the functions involved. It also gives the reader a geometric insight into the working of the multiplier. Possible simplifications, if the functions involved are homogeneous, are displayed.

ORC 77

Greene, Marjorie J., "A Reference-Connecting Technique for Automatic Information Classification and Retrieval," 21 pp., 10 Mar 1967, AD 654 190

A recent study of command information flow associated with the Dominican Republic coup of April-May 1965 introduced an analytical tool for identifying deficiencies in the flow and use of information which appears to have considerable potential as a general technique for information retrieval. Naval messages are associated with each other through their formal references. "Reference-connected sets" are then constructed from message traffic dealing with the coup and are found to uniquely identify operational events during the crises. This technique, if applied to a library system, avoids both the problem of describing the subject covered in a document and the problem of integrating new subject matter into a predetermined classification code.

ORC 79

Bram, Joseph, "Confidence Limits for System Reliability," 10 pp., 2 Feb 1968, AD 666 560

Formulas are derived for estimating the reliability P of a system containing r independent components with differing reliabilities, and confidence intervals for P. The use of the formulas is illustrated by an example.

ORC 80

Kenney, Mary R. and Spitz, Hillel, "Comparative Accuracy of Two Passive Range Finding Systems," 13 pp., 5 Mar 1968, AD 667 573

Evaluation of the relative effectiveness of two passive range finding systems requires the determination of how accurately the length of a side of a triangle can be calculated when the accuracies of measurement of two angles and another side are known. The accuracy achieved using the angles adjacent to the unknown side is compared with that resulting from using the angles adjacent to the known side.

ORC 81

Wilson, James C., "Computer Calculations of Discrete Fourier Transforms Using the Fast Fourier Transform," 15 pp., 5 Jun 1968, AD 673 442

A computer program (CNA 76-67) which determines the Discrete Fourier Transform of a set of data, using a recently developed technique known as the Fast Fourier Transforms is described. The relation between Discrete Fourier Transforms and Fourier Series when the data is periodic is also shown.

ORC 83

Baumgarten, Erwin, "Preliminary Cost Considerations for Concept Formulation of a Deployable Undersea Surveillance System," 6 pp., Aug 1968, AD 853 058

The framework of cost analysis for the evaluation of alternative deployable undersea surveillance systems is outlined. It is published as an example of the structure of a typical cost analysis for comparison of naval systems. Specific costs are not addressed.

SECTION III

F. SYSTEMS EVALUATION GROUP

Studies

SES 13

Cohan, Lawrence S., Heider, Charles H., and Mitchell, Thaddeus R., "The Utility of High-Performance Watercraft for Selected Missions of the United States Coast Guard," 312 pp., Nov 1972, (See also, Donnelly, J. P., Mitchell, Thaddeus R., and Neuendorffer, J. A., "Observations of the Performance of Tucumcari (PGH-2) in U.S. Coast Guard Mission Oriented Trails," supplement to SES 13, 58 pp., Mar 1973)

This report examines the effectiveness and cost of high-performance watercraft used in three specific missions of the U.S. Coast Guard: Search and Rescue (SAR), Aids to Navigation on the Western Rivers, and Marine Fisheries Law Enforcement. A historical SAR data base is analyzed and the inclusion of air cushion vehicles (ACVs) in the SAR force mix is examined. The utility of ACVs and faster conventional river tenders on the western rivers is analyzed. A hydrofoil is compared with conventional Coast Guard cutters and patrol boats for use in the marine fisheries law enforcement mission.

Research Contributions

SRC 1

Noah, Joseph W., "Concepts and Techniques for Summarizing Defense Systems Costs," 49 pp., 24 Sep 1965, AD 624 447

Some techniques used to summarize total costs employed in systems analyses are classified, described, and compared. Their respective advantages and disadvantages are given, and some implications of each are discussed. Five cost-summarizing techniques are selected, and distinctions between them are based on common usage. The procedures are termed: Five-year System Cost, Period Outlay, Net Cost, Present Cost, and Annual Cost.

SRC 6

Kemp, Bernard A., "More on Measures of Market Structure," 35 pp., 21 Sep 1966, AD 641 822

An index of market structure called the Lagged Rank index is developed in this paper. It measures the influence that firms are likely to have over the market. It takes account of the influence

that is likely to result either because the market has few firms or because the firms are of unequal size.

SRC 8

Cotton, James L., "Cost Analysis for the Development of Cost Estimating Relationship for Determining Investment Costs for Surface Effect Ships," 28 pp., Dec 1967, AD 829 419

Equations suitable for future construction (investment) cost estimating of Surface Effect Ship types when certain basic design information is known are provided. The equations are derived from plotted data reflecting calculated relationships between known design and cost data from 3 Navy hydrofoil craft.

SRC 9

Broussalian, Vartkes L., "The Evaluation of Non-Marketable Investments," 53 pp., Oct 1966, (Revised version of CRC 15) AD 652 821

The evaluation of non-marketable investments, of which defense projects are the most typical, presents difficulties not encountered in the case of marketable investments. The net effect of these difficulties is to render the operation of discounting, which is implied by economic theory for the evaluation of marketable investment, meaningless.

SRC 10

Broussalian, Vartkes L., "On Discounting and Risk in Military Investment Decision," 12 pp., 18 Aug 1966, AD 641 170

The term "discounting" is often applied indiscriminately to two distinct operations. One operation, which attempts to simulate the capital market's evaluation of an investment, represents a conceptual exchange between current and future income resulting in a "present value." The other refers to an essentially subjective revision, normally downward, of an expected future benefit or cost, for any of a number of reasons. It is pointed out that in the case of a military effectiveness stream (a typical example of a non-marketable benefit stream), it is meaningless to discount in the first sense. On the other hand, whereas discounting in the second sense could be meaningfully applied, there is no single rate which the analyst acting on behalf of the decision-maker can apply.

SECTION III

G. ARTICLES APPEARING IN PROFESSIONAL JOURNALS

A 1001

Aller, James C., Ayers, W. R.* (M.D.), Caceres, C. A.* (M.D.), and Cooper, J. K** (M.D.), "Systems Analysis of Operational Data from a Multiphasic Screening Center," (Published in IEEE Proceedings, Vol. 57, No. 11, Nov 1969)

Operational data from a multiphasic test center operated by the Alexandria Hospital Department in October 1967 is subjected to systems analysis to derive implications for sensor management. A simulated data process with capability for on-line test modification to assemble partial records and to give retest if necessary was studied. Besides the payoff of control of patient apathy and early treatment of suspect individuals, additional benefits may be possible.

*National Center for Health Services Research Development, Medical Systems Development Laboratory.
**Regional Medical Program Service, Heart Disease Control Program.

A 1002

Barfoot, Charles B., "The Lanchester Attrition-Rate Coefficient: Some Comments on Seth Border's Paper and a Suggested Alternate Method," (Published in Operations Research, Vol. 17, No. 5, Sep-Oct 1969)

This note presents some comments on Border's paper on the Lanchester attrition-rate coefficient, which indicate that a valid prediction of average attrition is obtained by using the harmonic mean of the variable attrition rates rather than the arithmetic mean. This change results in a constant Lanchester attrition-rate coefficient being defined as the reciprocal of the expected time to kill a target. An alternate and more general method for obtaining the constant coefficient is presented and some comparative results are displayed. An appendix indicates the conditions for which it is appropriate to use the harmonic and arithmetic means of rates in general.

A 1003

Boodman, David M., "The Reliability of Airborne Radar Equipment," (Published in Journal of the Operations Research Society of America, Vol. 1, No. 2, Feb 1953; Presented at the Operations Research Society of America Meeting, Nov 1952)

Since many situations requiring highly complex machinery also require a high degree of reliability, designers and users alike are confronted with the problems of deciding what degree of reliability in a given operation is acceptable and of determining the degree of complexity in a machine that will decrease the reliability beyond this acceptable value. This paper examines these questions as they pertain to airborne radar equipment, whose growth in complexity in recent years has paralleled that of Naval electronics in general.

A 1004

Bram, Joseph, "The Lagrange Multiplier Theorem for Max-Min with Several Constraints," (Published in the Society for Industrial and Applied Mathematics Journal, Vol. 14, No. 4, Jul 1966)

The object of this note is to extend the Lagrange multiplier result of Danskin's "On the Theory of Min-Max" (A 1028) which was given for a simple constraint $x_1 + \ldots + x_n = X$, $x_1 + \ldots + x_n = X$, $x_j \geqslant 0$, $i = 1, \ldots, n$, to the general case of several constraints of the form $g_j(x) \leqslant 0$, $j = 1, \ldots, m$. The result also generalizes the theorem of Kuhn and Tucker.

A 1005

Coile, Russell C. and Foster, Baba, "Use of Computer for Mechanized Literature Searching in Operations Research Libraries," (Published in Operations Research, Vol. 6, No. 3, May-Jun 1958; Presented at the 5th Annual Meeting, Operations Research Society of America, May 1957)

Documentation techniques have been developed for computing machines to carry out routine literature searching and preparation of bibliographies. In the multi-concept, post-combination system described, the machine searches through a portion or all of the documents listed in its storage and selects only those items with the desired combination of characteristics. Punched cards are used both as input to computing facilities and as manual card catalogs.

A 1006

Coile, Russell C., "Information Sources for Electrical and Electronics Engineers," (Published in IEEE Transactions on Engineering Writing and Speech, Vol. EWS-12, No. 3, Oct 1969)

Sources of information for electrical and electronics engineers have been studied by looking at 1965 IEEE publications to see what periodicals, books, conferences, etc., were cited.

ARTICLES

A 1007

Danskin, John M., "A Game Theory Model of Convoy Routing," (Published in Operations Research, Vol. 10, No. 6, Nov-Dec 1962)

This paper considers a nonlinear two-person zero-sum game in which one of the players plays over the direct product of two spaces. In fact, he allocates ships and escort vessels, separately, to various routes, and his antagonist allocates submarines to the various routes. Its interest lies first in the methodology connected with the curious nature of the one player's space, and second in its conclusions and some economic considerations related to them, for example, the virtual cost of a route.

A 1008

Danskin, John M., "A Game Over Spaces of Probability Distributions," (Published in ONR Naval Research Logistics Quarterly, Vol. 11, Nos. 2 & 3, Jun-Sep 1964)

This paper analyzes a two-person zero-sum game in which the strategies on the two sides are probability distributions. The solutions always turn out to contain jumps. In most cases the distributions are combinations of delta functions and density functions. The problem is as follows: A submarine chooses a range r, within a declared war zone, at which to fire his missile. If he is detected at a larger range he attempts to fire at that larger range with the effectiveness at that range decreased by defense measures such as attempts to kill the submarine, shoot down the missile, or protect the target.

A 1009

Danskin, John M., "The Effectiveness of Mobile Logistic Support," (Published in Journal of the Operations Research Society of America, Vol. 11, No. 4, Jul-Aug 1963)

A method for determining quantitatively an optimum logistic support system for the support of offensive naval operations is devised. The theory permits the determination of the best number, sizes, and locations of advanced bases, the optimum allocation of shipping to those bases, and the best allocation of resources between bases and support ships. The theory is applied to a hypothetical example and methods for computation are described in detail.

A 1010

Engel, Joseph H., "A Verification of Lanchester's Law," (Published in Journal of the Operations Research Society of America, Vol. 2, No. 2, May

1954; Presented at the Boston Meeting of the Operations Research Society of America, Nov 1953)

The validity of Lanchester's equations is demonstrated in an actual combat situation where U.S. forces captured the island of Iwo Jima. The equations tested are $dM/dt = P(t)-AN$, and $dN/dt = -BM$, with t the time elapsed since the beginning of the engagement, measured in days; $M(t)$ and $N(t)$, the number of effective friendly and enemy troops, respectively; A and B the friendly and enemy combat loss rates, respectively, per opposing combatant; and $P(t)$, the rate friendly troops enter combat.

A 1011

Engel, Joseph H., "Operations Research for U.S. Navy Since World War II," (Published in Journal of the Operations Research Society of America, Vol. 8, No. 6, Dec 1960)

Assesses some of the major trends that the Operations Evaluation Group of the Center for Naval Analyses has experienced since World War II, and some conclusions.

A 1012

Friedheim, Robert L., "Understanding the Debate on Ocean Resources," (Published in Monograph Series in World Affairs, Vol. 6, No. 3, University of Denver, 1969; The Law of the Sea Institute, Occasional Paper No. 1, Kingston, Rhode Island, 1969)

Emerging from the debate over ocean resources are some ideas which might be termed models, analogs, or constructs. These provide the intellectual substructure for more specific schemes for dealing with allocation of the oceans, many of which would rely heavily upon or specifically abjure, international-organization solutions. If we are to understand the debate over ocean resources, we must deal with these basic modes. The whole spectrum of ideas on allocation of ocean resources can be fit into four models: (1) normative nationalism, (2) functional nationalism, (3) functional internationalism, and (4) normative internationalism. Within each of these models there is a spectrum of real schemes which embody one or more fundamental characteristics of the model. In this paper we are trying to create substantive or symbolic models.

A 1013

Hardy, William C., "A Recursion Method of Solution for Occupancy Problems," (Published in SIAM Journal on Applied Mathematics, Vol. 17, No. 1, Jan 1969)

The model for the classical occupancy problem is

A 1013–Continued

an experiment in which a number of balls is randomly distributed among a fixed number of cells, and the question asked; "How many cells may we expect to contain k balls?" Standard solutions to this problem are obtained by more or less direct combinatorial computations. This paper exhibits a recursive solution, which the author has found to be quite useful for treating variations of the classical problems.

A 1014

Horvath, William J., "Operations Research—A Scientific Basis for Executive Decisions," (Published in the American Statistician, Oct 1948)

Discusses the nature of operations research and its value in the study of non-military problems that occur in the workings of a modern society.

A 1015

Kadane, Joseph B., "Quiz Show Problems," (Published in the Journal of Mathematical Analysis and Applications, Vol. 27, No. 3, Sep 1969; Available from Cowles Foundation for Research in Economics, Yale University) (Supersedes NRC 45)

A quiz show contestant may choose the category of his next question. Associated with each category a is a probability of P_a of knowing the right answer to the questions. If he answers the question correctly the contestant will be given a reward x_a and be required to choose a category not previously chosen. If he answers incorrectly, he will receive the consolation prize y_a and will leave the game with y_a plus his previous earnings. Suppose also that entering category a will require time t_a to recover and be ready to choose another question. Knowing a discount rate $\beta \geqslant 0$ and the parameters p_a, x_a, y_a, and t_a, how should the contestant choose categories to maximize his expected discounted winnings? This question divides into two connected parts. Given that the contestant has decided to attempt a set R of r categories, what is the optimal order in which to attempt them? Second, if there are n possible categories ($n \leqslant \infty$) of which the contestant may choose r, which are the optimal categories to choose?

A 1016

Knapp, Harold A., "South Woodley Looks at the H-Bomb," (Published in the Bulletin of the Atomic Scientists, Vol. X, No. 8, Oct 1954)

The main object of this article is to determine the shelter, warning, firefighting, and medical requirements for South Woodley on the basis of information about thermonuclear weapons and

their effects which have been made public; a second objective is to point out what specific technical information is still badly needed for civil defense planning.

A 1017

Kooharian, Anthony and Saber, N.* and Young, H.,** "A Force Effectiveness Model with Area Defense of Targets," (Published in Journal of the Operations Research Society of America, Vol. 17, No. 5, Sep-Oct 1969; Supported by Applied Research Lab., Sylvania Electronics Systems)

This paper describes an analytic method for computing the effectiveness of an ICBM force for the assured destruction mission, in which the missile force must attack a number of targets of different value, all protected by a fully preferential armed defense. The paper derives the optimum employment of the missile force and the area defense, and proves that, in the presence of an area defense, the terminal interceptor stockpile should be allocated among terminally defended targets strictly in proportion to their value. Because of its simplicity, the inclusion of defense penetration parameters, the allowance for several types of re-entry vehicles, and its two levels of defense, the model is useful as a force evaluation submodel in force-mix, force-defense, and re-entry-vehicle configuration studies.

*Mitre Corporation.
**University of Rochester.

A 1018

Lamar, Edward S., "Size, Shape, and Contrast in Detection of Targets by Daylight Vision. II. Frequency of Seeing and the Quantum Theory of Cone Vision," (Published in Journal of the Optical Society of America, Vol. 38, No. 9, Sep 1948)

Frequency of seeing curves have been obtained for targets having various image perimeters at background brightnesses of 2950 and 17.5 footlamberts, respectively. A description of the data has been obtained on the basis of the assumption that the absorption of a light quantum by a foveatal cone is a random event which is subject to the laws of chance.

A 1019

Levine, Daniel B. and Singer, Neil M., "On the Mathematical Relation Between the Income Function and the Measurement of Income Inequality," (Published in Econometrica, Mar 1970)

This paper presents a general formalism for calculating the effect of taxes on income distribution, and the resultant effect on income inequality. We first derive a closed form expression for income

ARTICLES

A 1019—Continued

inequality, defined from a Lorenz curve, in terms of the income density function. By way of illustration, we use this expression to calculate the effect of a proportional and a lump sum tax on income inequality of a simple exponential income distribution.

A 1020

Coile, Russell C., "Ages of Creativeness of Electronic Engineers," (Published in Proceedings of the I.R.E., Vol. 42, No. 12, Dec 1954)

A study of ages of electronic engineers publishing papers in the Proceedings of the I.R.E. has indicated that more papers are published by engineers in the 30-34 year age period than at other ages. If we accept that publishing papers in a professional society journal with its normal reviewing system is one measure of creativity, then perhaps this bit of information may be of value in connection with the shortage of engineers.

A 1021

Blechman, Barry M., "The Quantification of Foreign Policy Alternatives: Sinai, 1956," (Published in Journal of Conflict Resolution, Vol. X, Dec 1966)

This article describes a methodology for the measurement of the perceived benefit associated with each foreign policy alternative available to a nation in a particular situation. The methodology, derived from standard techniques used in operations research, is applied to the decision makers in the Fall of 1956. The results of the analysis supports the action taken by Israel.

A 1022

Mela, Donald F., "Information Theory and Search Theory as Special Cases of Decision Theory," (Published in Journal of the Operations Research Society of America, Vol. 9, No. 6, Nov-Dec 1961)

It is fairly widely realized at this time that a procedure that yields the highest probability of detection in a search problem will not necessarily be the one that maximizes the expected information gained, as given by the standard definition of information theory. It is the purpose of this note to indicate with some simple examples that the connection between the information theory approach is tenuous and that search problems can be better regarded as an application of the more general theory of statistical decisions.

A 1023

Boness, A. James and Schwartz, Arnold N., "A Cost Benefit Analysis of Military Aircraft Replacement Policies," (Published in ONR Naval Research Logis-

tics Quarterly, Vol. 16, No. 2, Jun 1969; Revised version of IRC 23)

This paper describes a method of solving aircraft service life problems. It discusses replacement policies for aircraft used in the Naval advanced jet pilot training mission. Taking engineering technology and the training syllabus as given, four feasible plans for introducing replacement aircraft into service are evaluated in terms of the present values of differential costs associated with the plans and in terms of the likely errors in cost estimates used in calculation of the present values. The trade-off between present value of costs and planning flexibility is emphasized in choosing a recommended time pattern of aircraft replacement. The specific aircraft mixes considered are the TF-9J/TAF-9J and the TA-4F/A-4B. The first is the currently employed mix; the second, is the proposed replacement.

A 1024

Stearns, Charles M., "Operations Research in the Navy," (Published in ONR Research Reviews, Oct 1952)

Brief discussion regarding the application of operations research in the Navy.

A 1025

Steinhardt, Jacinto, "Terminal Ballistics," (Published in Journal of the Operations Research Society of America, Vol. 3, No. 3, Aug 1955; Presented at the 3rd Annual Meeting, Operations Research Society of America, Jun 1955)

Address of the retiring president of the ORSA, on the expansion of operations research into industry and government.

A 1026

Coile, Russell C., "Periodical Literature for Electrical Engineers," (Published in Journal of Documentation, Vol. 8, No. 4, Dec 1962)

A study of problems of documentation in electrical engineering is being made at the Vail Library of the MIT. This paper reports some of the preliminary progress.

A 1027

Fain, William W., Fain, Janice B., and Karr, H. W.,* "A Tactical Warfare Simulation Program," (Published in ONR Naval Research Logistics Quarterly, Vol. 13, No. 4, Dec 1966)

The Tactical Warfare Simulation Program is a procedure by which the major interactions among opposing military units and terrain features can be treated in a tactical limited warfare situation. It is a critical area, sequence-of-event

A 1027–Continued

model and is programmed in SIMSCRIPT. In this program a military unit is described by such properties as strength, size, location, velocity, and attrition rates. Some of the events which can occur to a military unit are entering/leaving, terrain features, becoming engaged/disengaged with opposing units, retreating, reaching an objective, and breaking. Following a discussion of the general features of the program, a study of a hypothetical war is presented.

California Analysis Center, Inc.

A 1028

Danskin, John M., "The Theory of Max-Min, with Applications," (Published in the Society for Industrial and Applied Mathematics Journal, Vol. 14, No. 4, Jul 1966; Presented at the NATO Conference on the Theory of War Games, Jun 1964)

This paper is concerned mainly with two-stage max-min problems, in which the minimizing player acts after the maximizing player and with full knowledge of the choice of the maximizing player. Such problems arise in operations research for instance when defense installations must be built in concrete long before a battle, while the attack against them is made in full knowledge of what they are. Such problems are not games in the usual sense. To treat them it was necessary to invent a new kind of derivative and to study its very peculiar properties. Using the derivative, this paper sets forth a general theory of max-min analogous to the elementary theory of maximizing for finite problems, applies this to find criteria in a long unsolved allocation problem, and finally, with a slight modification, generalizes and proves the theory in economics known as Frank Knights theorem.

A 1029

Morse, Philip M., "Operations Research: An Application of Scientific Method," (Published in Technology Review, Vol. 55, No. 7, May 1953)

Discusses the techniques of operations research and outlines a few of the mathematical models which are used in operations research.

A 1030

Steinhardt, Jacinto, "The Role of Operations Research in the Navy," (Published in the United States Naval Institute Proceedings, Vol. 72, No. 5, May 1946)

A discussion of the applications of operations research methods in the Navy during World War II.

A 1031

Kittel, Charles, "The Nature and Development of Operations Research," (Published in Science, Vol. 105, No. 2719, 7 Feb 1947)

Discusses the origin of operations research; its personnel, problems, and applications.

A 1032

Kadane, Joseph B. and Maddala, G. S.,* "Some Notes on the Estimation of the Constant Elasticity of Substitution Production Function," (Published in Review of Economics and Statistics, Vol. XLVIII, No. 3, Aug 1966)

Ever since the appearance of the Arrow, et al., paper, "Capital-Labor Substitution and Economic Efficiency," the constant elasticity of substitution (CES) production function has figured prominently in econometric work. Most investigators have been interested in the estimation only of the elasticity of substitution, rather than of all the parameters of the production function. Most of these estimates have been based on the single equation approach based on the marginal productivity condition for labor. However, this is only one of the equations in the complete model. Making reasonable assumptions about what variables are to be taken as exogenous, a new estimator of the elasticity is found which has smaller mean-squared error than the usual one.

University of Rochester.

A 1033

Kadane, Joseph B. and Maddala, G. S.,* "Estimation of Returns to Scale and the Elasticity of Substitution," (Published in Econometrica, Vol. 35, Nos. 3-4, Jul-Oct 1967)

This paper concerns itself with the following problem: Suppose the true production function is of the constant elasticity of substitution type with constant returns to scale. If we fit an unrestricted Cobb-Douglas production function instead, what is the nature of the bias in the estimate of the returns to scale parameter?

University of Rochester.

A 1034

Kadane, Joseph B., Moses, L. E.,* Brody, R. A.,* Holsti, O. R.,** and Milstein, J. S.,[†] "Scaling Data on Inter-Nation Action," (Published in Science, Vol. 156, No. 3778, May 1967)

This article presents a method which has been developed to permit comparison of variables such as aggression and hostility for separately judged situations. The methods should be useful in any branch of social science where numerical scores

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A 1034—Continued

are best assigned by ranking all specimens or a sample of specimens within a domain of discourse.

*Stanford University.
**University of British Columbia.
†Yale University.

A 1035

Kadane, Joseph B., "Some Equivalence Classes in Paired Comparisons," (Published in Annals of Mathematical Statistics, Vol. 37, No. 2, Apr 1966)

In a paired comparison experiment n judges give a preference in some or all of the $\binom{t}{2}$ pairs of t items. Frequently the purpose of the experiment is to test null hypothesis that every preference is equally likely against a vaguely defined alternative of consistency. Our purpose is to study several of the tests used, from the point of view of a natural equivalence relation which arises in graph theory.

A 1036

Kadane, Joseph B. and Lewis, Gordon H.,* "The Distribution of Participation in Group Discussions: An Empirical and Theoretical Reappraisal," (Published in the American Sociological Review, Oct 1969)

The distribution of participation in small task-oriented group discussions has been described as harmonic by some researchers and as exponential by others. With evaluations based on different measures of goodness of fit, the harmonic function was rejected, and the exponential function accepted in its place. Reanalysis of the evidence shows that the exponential function does not describe the data any better than the harmonic. Several attempts have been made however, to explain why an exponential relation should occur. Since no explanations have been offered for the harmonic, the existence of explanations for the exponential relation should play a crucial role in the choice of a description. Analysis of the proposed explanations of the exponential reveals them to be inadequate.

*Carnegie-Mellon University.

A 1037

Kadane, Joseph B., "Discrete Search and the Neyman-Pearson Lemma," (Published in Journal of Mathematical Analysis and Applications, Vol. 22, No. 1, Apr 1968)

Suppose an object is hidden in one of n boxes. A strategy for finding it is a sequence of boxes (finite or infinite). For example, (3, 1, 2, 5, 3, . . .) is interpreted to mean that box 3 is to be searched first; if the object is not found, then box 1 is to be searched, ... It is not assumed that a search of the box containing the item is

sure to be successful, so the second search of box 3 (the fifth search above) might succeed. Each strategy has a probability of finding the object, and has a cost associated with each possible outcome, both subject to conditions described as follows. The main problem considered here is how to choose a strategy to maximize the probability of finding the object when a budget ceiling is imposed.

A 1038

Kadane, Joseph B., Lewis, Gordon H.,* and Ramage, John G.,* "Horvath's Theory of Participation in Group Discussions," (Published in Sociometry, Vol. 32, No. 3, Sep 1969; Cowles Foundation for Research in Economics, Yale University, Foundation Paper No. 310)

Horvath's theory of participation in discussion groups is compared to data from several studies. Both visual evidence of graphs of the parameter space and tests of significance indicate to us that the theory is weak in its description of the proportion of acts initiated by members of the group. This failure is important since the theory was apparently developed to explain this aspect of group discussions.

*Carnegie-Mellon University.

A 1039

Kadane, Joseph B., Lewis, Gordon H.,* and Ramage, John G.,* "Rejoinder to Horvath," (Published in Sociometry, Vol. 32, No. 4, Dec 1969; Cowles Foundation for Research in Economics, Yale University, Foundation Paper No. 310)

Rejoinder to Horvath's comments on A 1038 appearing in Sociometry, Vol. 32, No. 3, Sep 1969.

*Carnegie-Mellon University.

A 1040

Coile, Russell, C., "Economograph for Determining FM Station Costs," (Published in TELE-TECH (Electronic Industries), Vol. 6, No. 12, Dec 1947)

The nomographs permit quick calculation of the costs of establishing FM broadcast service and the effective radiated power for various investments.

A 1041

Kadane, Joseph B., "Comparison of K-Class Estimators when the Disturbances are Small," (Published as Cowles Foundation for Research in Economics, Yale University, Discussion Paper No. 269; Published in Econometrica, Sep 1971)

The study of simultaneous equation econometric models has led to many estimators alternative to

A 1041–Continued

ordinary least squares; single-equation limited information maximum likelihood and two-stage least squares, for example. However, the behavior of these estimators has been difficult to describe, and it has been difficult to choose among these estimators. The work described in this paper explores this problem in the case in which lagged dependent variables are not permitted.

A 1042

Aller, James C., "Electronic Warfare Concept," (Published in Naval War College Review, May 1970)

The complexities of electronic warfare often discourage the amateur from attempting to understand the basic concepts involved. These concepts have retained their validity over the broad sweep of history, but the techniques for achieving them have changed dramatically in recent years. If the commanding officer achieves an understanding of these concepts and a knowledge of the capabilities of the equipment in his command, he will be able to manage his units effectively without detailed technical training.

A 1043

Stoloff, Peter H., "A Generalized Method for Generating Random Numbers Using a Large Family of Stochastic Functions," (Published in Educational and Psychological Measurement, Vol. 28, 1968)

The digital computer has found widespread usage in the behavioral sciences as a tool for the simulation of probabilistic data. Of particular importance is the simulation of sample distributions which may be used to make inferences as to the characteristics of the populations from which they were sampled. The core of this stochastic process is the random number generator. This paper describes a generalized computer program which, unlike most random number generators, enables the user to generate random numbers describable by any one of a large class of distribution functions by varying only a single statement in the program.

A 1044

Stoloff, Peter H., "PEER: A PEER Rating and Sociometric Data Analyzer," (Published in Computers in Behavioral Science, Vol. 14, 1969; Supported by Peace Corps Contract PC-80-1057)

PEER nominations have been shown to be valid predictors of performance in the Peace Corps and have value as descriptors of leadership and popularity structure within small groups. The conventional method of scoring PEER nominations is to tabulate the number of times each group number

is chosen by others for each item on the nomination form. This frequency data is commonly presented in terms of raw popularity scores. PEER provides a variety of popularity scores for each PEER group member. These include mean popularity of other PEER group members whom he chose; mean popularity of those he was chosen by; mean popularity of those reciprocating his nomination; as well as the conventional popularity score.

A 1045

Stoloff, Peter H., "Detection and Scaling of Statistical Differences Between Visual Textures," (Published in Perception and Psychophysics, Vol. 6, 1969)

Stochastically textured patterns were used to investigate the sensitivity of Ss to differences in the statistical distribution of locally defined properties of element density and shape. The results of the study indicate that when the textures were most structured, in terms of their variance, Ss were most accurate at detecting dissimilarities between pairs of patterns. Ss also rated the similarity of the statistical distributions of elements of patterns differing in local properties. Multidimensional scaling analysis of the ratings showed two dimensions, representing monotonic orderings of the stimuli.

A 1046

Coile, Russell C., "Libraries for Engineers and Scientists," (Published as University of Kentucky Libraries Occasional Contribution No. 61, Feb 1954)

A library is an information processing center where raw information is organized, classified, translated, abstracted, and put into storage. The information processing, storing and retrieval systems must be an integrated systems design. A library machine using post-combination concept coding may be of great value in a mechanized library.

A 1047

Coile, Russell C., "Scientific Aids to Documentation," (Published as University of Kentucky Libraries Occasional Contribution No. 61, Feb 1954)

Scientific aids to library operation have been slow in evolution partly because the precise problems to be solved have not been formulated. An analysis of the functions of the library and the philosophy of organization and classification of information enabled specific requirements to be stated for a library machine. These requirements for storage, selection, output, performance and cost have been used to determine the design of a proposed Library Abstract Machine.

ARTICLES

A 1048

Coile, Russell C. and Culmsee W., "Note on Thunderstorms at High Altitudes in the Tropics," (Published in the Journal of Geophysical Research, Vol. 58, No. 2, Jun 1953)

Compilation of some of the thunderstorm data recorded at the Huancayo Magnetic Observatory, Huancayo, Peru has revealed some interesting points of comparison with the data published by C. E. P. Brooks in his monograph, "The Distribution of Thunderstorms Over the Globe" (London, Meteorological Office, Geophysics Memo No. 24, 1925).

A 1049

Coile, Russell C., "Radar Antenna Beamwidth," (Published in Electronic Engineering (London, England) Vol. 25, No. 302, Apr 1953)

A nomograph permits rapid evaluation of the effects of various antenna sizes and frequencies of operation on the radar antenna beamwidth.

A 1050

Coile, Russell C., "Periodical Literature for Electronic Engineers," (Published in Proceedings of the IRE, Vol. 38, No. 12, Dec 1950)

Problems of periodical literature for electronic engineers have been examined from the reader's point of view. A suggested list of periodicals ranked by relative usefulness based on footnote reference citations is given.

A 1051

Coile, Russell C., "Parabolic Sound Concentrators," (Published in Journal of the Society of Motion Pictures Engineers, Vol. 51, No. 3, Sep 1948)

Parabolic sound concentrators have long been investigated for application to military anti-aircraft location, radio broadcasting and motion picture recording. This paper presents the pertinent historical background and reports on an experimental verification of the theoretical acoustical directivity of parabolic concentrators as well as further checks of the amplification theory. The sound fields inside parabolic reflectors have also been investigated experimentally with agreement found with theoretical fields calculated by principles of geometrical optics.

A 1052

Coile, Russell C., "Radar Pulses on Target per Scan," (Published in Electronic Engineering (London), Vol. 25, No. 300, Feb 1953)

A nomogram has been developed which permits rapid calculation of the number of radar pulses on target per scan as a function of antenna rotation rate, antenna beamwidth and pulse repetition frequency.

A 1053

Mintz, Jeanne S., "Review of Indonesia, a Book by Bruce Grant," (Published in Journal of Asian Studies, Vol. XXVII, No. 3, May 1968)

A 1054

Rellahan, William L., Bender, Daniel F.,* and Thippeswamy, Thuduma,* "A Nonlinear Hammett Plot. Substituent Effects in the Substitution and Elimination-Rearrangement Reactions of 1,1-Diaryl-2-bromoethenes with Potassium t-Butoxide in an Aproctic Solvent," (Published in the Journal of Organic Chemistry, Vol. 35, No. 4, Apr 1970)

A series of 1,1-diaryl-2-bromoethenes was synthesized and allowed to react with potassium t-butoxide in anhydrous diglyme at $0°$. The substitution products were isolated by solvent extraction and column chromatography and identified by nuclear magnetic resonance spectrometry and elemental analysis. The elimination-rearrangement products were identified by ultraviolet spectrophotometry. The rate constants for the rearrangements step were calculated by the time-ratio method.

Career Development Program, U.S. Department of Health, Education and Welfare, U.S. Public Health Service.

A 1055

DiBona, Charles J., "The Future of the Merchant Marine," (Published in the Armed Forces Journal, 15 Feb 1969)

For the first time since World War II there is a demonstrated opportunity for the U.S. merchant marine to achieve the ability of other U.S. industries to compete with foreign counterparts. But we must act now. If we are to become competitive, or nearly so, with foreign shipping, every element of the industry must be open to innovation.

A 1056

Stoloff, Peter H., "Correcting for Heterogeneity of Covariance for Repeated Measures Designs of the Analysis of Variance," (Published in Educational and Psychological Measurement, Vol. 30, No. 4, Winter 1970)

It has been contended that in many instances the repeated measures design of the analysis of variance has been improperly used. The univariate model assumes homogeneity of covariance which is seldom tested for, and oftentime violated. Some have shown that the effect of nonhomogeneous correlations, between treatments, is to

A 1056–Continued

introduce a positive bias in F when the correlations are positive but unequal and a negative bias when the correlations are negative but unequal. Various approaches have been suggested to contend with this bias; some are methodological, others focus on the choice of the statistical test, and some attempt to correct the biased F mathematically. Here, an attempt is made to account for a positive bias by a reduction of the degrees of freedom (df).

A 1057

Piersall Jr. Charles H. (LCdr. USN) and Platt. Stuart F., 'Water-Capacity Planning for Metropolitan Areas, The Case of Monroe County, N.Y.'," (Published in the Journal American Water Works Association, Vol. 63, No. 2, Feb 1971)

Creation of many small local districts has complicated and served to postpone area-wide solutions to water-resource management. Although the data in this article are specific to the Monroe County, N.Y., area, the proposals are not limited in scope of application.

A 1058

Kadane, Joseph B., "A Multinomial Sum," (Published in the American Mathematical Monthly, Apr 1971)

A combinatorial identity is proved which is a generalization of the multivariate Vandermonde equality. The problem arose from a statistical estimation problem.

A 1059

Wilson, Jr., Desmond P., "Defending Attack Carriers," (Published in the Letters section, The Washington Monthly, Jul 1970)

Response to John Wicklein's article entitled "The Oldest Established Permanent Floating Anachronism on the Sea," which appeared in the Washington Monthly February 1970 issue.

A 1060

Brown, Jr., George F. and Corcoran, Timothy M., "A Comment on a Paper by Goodwin and Giese," Nov 1969, (To be published in Operations Research, 1971)

In "Reliability of Spare Parts Support for a Complex System with Repair," Goodwin and Giese attempted to derive an expression for the probability that a given number of spares for each element of a complex system will be sufficient to ensure continued operation without requiring a spare when none is available. This paper calls

attention to an error in their analysis and presents and interprets the required modifications.

A 1061

Brown, Jr., George F., "Review of Uncertainty and Estimation in Economics Vols. I-III," (Published in the Journal of the American Statistical Association, Jun 1971)

This article reviews D. G. Champernowne's, "Uncertainty and Estimation in Economics," Volumes I-III.

A 1062

Brown, Jr., George F., "Review of Industry Production Behavior," (Published in the Journal of the American Statistical Association, Mar 1971)

This article reviews D. A. Belsley's "Industry Production Behavior: The Order-Stock Distinction."

A 1063

Wilson, Jr., Desmond P., "Evolution of the Attack Aircraft Carrier: A Case Study in Technology and Strategy," (Doctoral dissertation, Massachusetts Institute of Technology, 1966; Published in CVAN-70 Aircraft Carrier; Joint Hearings before the Joint Senate-House Armed Services Subcommittee of the Senate and House Armed Services Committees, 91st Congress, 2nd Session, 1970)

This study examines the Navy's requirements for attack aircraft carriers where alternative weapons capable of performing approximately the same missions have been or are available. The alternatives of the aircraft carrier and the battleship in the 1920's and 1930's are examined to determine how the Navy planned the composition of its World War II fleet. The largely unique role of the carrier in World War II is analyzed and contrasted with post-War carrier requirements when the Navy sought a nuclear delivery role then held exclusively by the Air Force. Finally, the limited war roles of carrier-based and land-based aviation are compared to determine some of the various political, cost, and operational factors which enter into decision on the nation's overall, tactical aviation requirements.

A 1064

Wilson, Jr., Desmond P., "Statement of Dr. Desmond P. Wilson before the CVAN-70 Aircraft Carrier; Joint Hearings before the Joint Senate-House Armed Services Subcommittee of the Senate and House Armed Services Committees, 91st Congress, 2nd Session, 1970," 4 pp., Apr 1970, (Published in the subject hearings)

ARTICLES

A 1065

Arnold, Robert D., "Rules Preparation and Pre-Game Activities," Nov 1961, (Published in the First War Gaming Symposium Proceedings, edited by John Overholt, Washington Operations Research Council)

An attempt is made to develop a set of general principles of war game preparation by viewing the technique in terms of its fundamental purpose, which is to organize existing knowledge in a manner suitable for guiding future actions. Realism of simulation, validity of inputs and sensitivity of results are discussed in this perspective.

A 1066

Howe, John A., "Wolfpack: Measure and Counter," (Published in Naval War College Review, Apr 1971)

Intelligence, communications, and submerged speed were the critical factors in wolfpack tactics in the Battle of the Atlantic. Despite postwar technological improvements in weapons systems and sensors employed by both submarine and antisubmarine forces (which have largely offset each other), the advances in submarine design permitting greater submerged mobility and decreasing vulnerability to surface detection have made coordinated attack feasible once again.

A 1067

Athay, Robert E., "The Sea and Soviet Domestic Transportation," (Published in the United States Naval Institute Proceeding, Naval Review, May 1972)

This article examines Soviet domestic transportation and shows that, notwithstanding the rapid growth in the merchant fleet, the traditional heavy orientation of the Soviet economy toward overland freight shipping has been retained.

A 1068

Halpern, Abraham M., "Contribution to China's New Diplomacy: A Symposium (II)," (Published in Problems of Communism, Jan-Feb 1972)

Discussion of the latest Chinese moves in foreign policy.

A 1069

Fulton, William L. (LCdr., USN) and Piersall, Charles H. (Cdr., USN), "An Analysis of Engineering System Degradation as a Function of Impact Level," (Published in the Naval Engineers Journal, Vol. 84, No. 1, Feb 1972)

A methodology for evaluating system survivability in a threat environment is presented. A model is developed using the principles of Markov chains. The primary thrust is an explanation of these principles and their usefulness in the analysis of a broad range of shipboard systems. For demonstrative purposes a destroyer escort propulsion plant will be modeled to demonstrate the methodology for evaluating system survivability. However, prior to further development of this model it is necessary to explain several terms and to establish mathematical relationships or properties of Markov chains that were used in the evaluation of this propulsion system.

A 1070

Merrill, Orin H., "A Summary of Techniques for Computing Fixed Points of Continuous Mappings," 21 Oct 1971, (Published in Mathematical Topics in Economic Theory and Computation, Society for Industrial and Applied Mathematics, 1972)

This paper summarized Scarf's algorithm and some related techniques for approximating fixed points of a continuous mapping from a closed simplex into itself. These methods can be used to approximate fixed points of certain upper semi-continuous point to set mappings and to solve certain nonlinear programming problems. Some recent results of Eaves and Saigal plus those of the author are also discussed.

A 1071

Coile, Russell C., "Doppler Radar Systems," (Published in Electronic Engineering (London), Vol. 25, No. 301, Mar 1953)

Doppler radar systems have many applications where their characteristics permit better performance than that obtainable from conventional pulse radar systems, such as in the detection of moving objects in the presence of large amounts of ground clutter, and the measurement of velocities of projectiles. A nomogram has been designed to allow calculation of the doppler frequency knowing the wavelength in centimeters or frequency in megacycles per second of the radar and the radial velocity of the target in miles per hour.

A 1072

Friedheim, Robert F., "The Satisfied and Dissatisfied States Negotiate International Law—A Case Study," 21 pp., Oct 1965 (Published in World Politics, Vol. XVIII, No. 1, Oct 65)

This article addresses itself—by an analysis of the content of the debates at Geneva—to the different attitudes that representatives of states and

A 1072 – Continued

bloc groups brought to the negotiating table. Because the difference in attitudes was so sharp, the conferences proved to be less successful than hoped for by advocates of world law. Not only were participants split on the question of the substantive content of the law, but they also differed on the nature of the international system, present and future, and on the proper means of negotiating law in a United Nations-sponsored conference, which is itself a special political area with distinctive characteristics.

A 1073

Hartka, Joseph E., "Temperature of a Semi-Infinite Rod Which Radiates Both Linearly and Nonlinearly," 10 pp., Jul 1974 (Published in Quarterly of Applied Mathematics, Vol. XXXII, No. 2, Jul 1974)

In the following work a constructive proof of the existence of a positive solution is presented and it is demonstrated that there can be only one positive solution to the nonlinear problem.

A 1074

Nunn, Walter R., "A Class of Combat Problems with a Semi-Markov Model," 26 pp., Apr 1975 (To be submitted for publication in Operations Research)

This paper treats a certain class of combat problems by using a semi-Markov model. The class of problems is informally characterized as follows: (1) There are only two opponents. (2) The combat is of finite, pre-fixed maximum duration T. (The combat must be capable of ending at any time prior to T.) (3) The status of the combat engagement must be capable of description with a finite number of descriptors. (The various classifications are the "states" of the system.) (4) Transition between states is governed by a set of known transition probabilities; the time spent in any state is a random variable with known distribution. Equations are derived which give the probabilities of a win or draw for each opponent as functions of time. By properly interpreting the equations the analyst may use them for both the semi-Markov model and for the "embedded" Markov model. The equations are solved by discretizing the problem and solving the resulting sets of linear equations recursively, as opposed to using transform methods. The resulting scheme has attractive numerical error characteristics. A numerical example is given for the analysis of a dogfight between jet aircraft loaded out with two missiles each.

A 1075

Kanter, Herschel E., Moore, Arnold B., and Singer, Neil M., "The Allocation of Computer Time by University Computer Centers," 10 pp., Jul 1968 (Published in The Journal of Business of the University of Chicago, Vol. 41, No. 3, Jul 1968)

Discussion of the allocation of computer time by university computer centers and how that allocation is affected by federal-government auditing rules.

A 1076

Wilson, Peter A., "Battlefield Guided Weapons: The Big Equalizer," 7 pp., Feb 75 (Published in the U.S. Naval Institute Proceedings, Feb 75, Vol. 101, No. 2)

The presence of battlefield guided weapons brought about important changes in behavior on an armed force relying heavily on aircraft and armored fighting vehicles to carry out offensive military operations. These effects were not so decisive as to determine the outcome of the battle; on the other hand, their performance does represent a portent of the future which should be strongly heeded by all elements of the USMC and the aviation community of the USN. All aspects of amphibious and land-combat operations will be affected by the appearance of battlefield guided weapons (BGWs).

A 1077

Coile, Russell C., "A New Application of Computer for Information Scientists," 4 pp. (Published in The Information Scientist, Vol. 9, No. 4, pp. 149-152, Dec 1975)

A computer program has been devised for preparation of papers for meetings by a don't-do-it-yourself system. An example, possibly suitable for conferences such as those held by the Institute of Information Scientists, is presented along with the actual program.

A 1078

Coile, Russell C., "Computing: A BASIC Approach," 3 pp. (Published in Informaniac, Journal of the Information Science Society, The City University (London), Spring 1975, pp. 18-20, ISBN 0904683 02 8)

Information scientists should take advantage of the introduction of computers into libraries and start computing using BASIC (Beginners All-purpose Symbolic Instruction Code). A bibliometric example is presented with the programming of Derek J. deSolla Price's formula for

ARTICLES

A 1078 – Continued
estimating the number of men who published at least P papers during a lifetime.

A 1079
Coile, Russell C., "Lotka and Information Science," 2 pp. (Published in the Journal of the American Society for Information Science, Vol. 26, No. 2, pp. 133-134, March-April 1975)

This Letter to the Editor presents a number of corrections for mathematical errors in a paper by H. Voos published in JASIS, Vol. 25, No. 4, pp. 270-272, July-August 1974 on Lotka's law of the frequency distribution of scientific productivity.

A 1080
Coile, Russell C., "Principles of Information Retrieval," (Accepted for publication by the Journal of Documentation, London, England)

This Letter to the Editor presents a number of corrections of mathematical errors in a book, *Principles of Information Retrieval* by Manfred Kochen. Data is presented to correct Kochen's erroneous opinion that the log-normal distribution gives a better fit than the Yule Beta-function distribution for predicting frequency distributions of scientific productivity of mathematicians and econometricians.

SECTION III

H. BOOKS

B 1

McConnell, James M., "Ideology and Soviet Military Strategy," (Published as part of "Aspects of Modern Communism," edited by R. F. Staar, 1968, University of South Carolina Press)

Discusses the fluctuations in Soviet military strategy since 1917 as a consequence of shifts in the Soviet ideological action program. The defensive strategy of the Leninist era stems from the concept of permanent revolution; the offensive strategy of the Stalinist era from Socialism in one country; and the return to the strategic defense in the post-Stalinist period flows logically from the notion of peaceful co-existence.

B 2

Overholt, John L., "The Problem of Factor Selection," (Published as part of "The Design of Computer Simulation Experiments," edited by T. H. Naylor, Duke University Press, Durham, North Carolina, 1969)

The proper selection of factors seems to be more difficult in computer simulations than in the laboratory or plant. The number of possible factors may be very large in simulations, which usually are not used unless the situation is complex. The problem is to select the most important factors so that a critical set of runs can be made in a reasonable time. The guidance on factor selection is summarized from the literature. A fact not mentioned in statistics texts is that the vantage point of the sponsor must be considered because it influences the choice of factors. In a budget submission, for example, one must prepare the best answer by a fixed date from a limited number of factors and refine the answer in subsequent cycles. The problem is compounded when many groups are interested in the outcome but each has its own facet of responsibility. Several examples of factor selection for designs used in the author's simulations are discussed. Such experiments have no residual error due to significant omitted factors. Instead Monte Carlo simulations may have binomial errors which may or may not be typical of the real world.

B 3

Danskin, John M., "The Theory of Max-Min and its Application to Weapons Allocation Problems," Springer-Verlag Berlin New York, Inc., 1967

Max-min problems are two-step allocation problems in which one side must make his move knowing that the other side will then know the optimal counter-move. They are fundamental in particular to military weapons selection problems involving large systems such as Minuteman or Polaris, where the systems in the mix are so large that they cannot be concealed from an opponent. One must then expect the opponent to determine on an optimal mixture of, in the case mentioned above, anti-Minuteman and antisubmarine effort.

B 4

Isaacs, Rufus, "Differential Games—A Mathematical Theory with Applications to Warfare and Pursuit, Control and Optimization," The SIAM Series in Applied Mathematics, John Wiley and Sons, Inc., New York, 1965 (s.a. CRC 1)

A differential game is one in which, as the action progresses, both the environment and the decisions available to the players are subject to a consistent, logical law, so that the problem is amenable to mathematical analysis. Usually, the action is continuous, and solutions can actually be obtained for a wide range of problems of extended conflict between two antagonists. The applications include various models of battles, pursuit and evasion games, dogfights and other contests of maneuvering, such as football, and some aiming and evasion problems. By allowing one player to be passive, certain programs can be optimized. The text concludes with chapters on the case of incomplete information and the practical aspects of applications to warfare.

B 5

Coile, Russell C., "Reverberation Time Nomographs," (Published as part of "Electronics Manual for Radio Engineers," edited by Vin Zeluff and John Markus, McGraw-Hill, New York, 1949; Originally published in Electronics, Vol. 20, No. 4, Apr 1947)

Reverberation time is the length of time required for the intensity of a sound to drop to one-millionth of its original intensity, which corresponds to a change of 60 decibels. The reverberation time of a room may be computed, knowing the dimensions of the room and the acoustical absorption coefficients of the different surfaces. Two nomographs have been designed to facilitate rapid calculation of reverberation time.

BOOKS

B 6

Devine, Eugene J., "Analysis of Manpower Shortages in Local Government: Case Studies of Nurses, Policemen and Teachers, Using a Monopsony Model," Frederick A. Praeger, Publisher, New York, 1970

The purpose of this study is to explain why local governments experience persistent job vacancies, or shortages for some types of employees, such as registered nurses, policemen and teachers, and not for the hundreds of other classes which they employ. An extension of monopsony theory has been developed which includes recruitment costs in addition to the usual variables of wages and number of employees. This theory states that a monopsonist who is unable to engage in wage discrimination will experience job vacancies in equilibrium and will neither raise wages nor increase recruitment expenditures sufficiently to eliminate them. The theoretical model is applicable to all monopsonistic employers, whether or not they are profit-maximizers. The hypothesis is that governments are sufficiently large employers of the shortage occupations as to be monopsonists with respect to these classes while they are competitive employers for the great majority of their job classes.

B 7

Moore, Arnold B., "Some Characteristics of Changes in Common Stock Prices," (Published as part of "The Random Character of Stock Market Prices," edited by Paul H. Cootner, MIT Press, Cambridge, Massachusetts, 1964)

This paper is concerned with successive movements in the prices of common stocks. The procedure adopted here is to review some previous work on speculative prices and other topics and relate it to the present value formula, a device frequently employed in discussion of capital values. The analysis of new data reveals an unexpected difference between the behavior of individual securities and indices, and the remainder of the paper is devoted to various explanations of the observed difference. The orientation of the paper is toward estimation of characteristics of stock price behavior rather than testing of fully specified hypotheses.

B 8

Wilson, Jr., Desmond P., "Cuban-Soviet Relations: Conditions and Constraints," (Published as part of "Aspects of Modern Communism," edited by R. F. Staar, University of South Carolina Press, 1968)

Competition and conflict between the communist and non-communist states have created a number of political anomalies throughout the world. Cuba is one of these. The significant prevailing conditions with regard to Cuba are those which stem from geography and from the almost complete economic and diplomatic isolation of Cuba within the Western Hemisphere. The constraints on Cuba and the Soviet Union concern the introduction into Cuba of offensive strategic weapons and the use of the island as a base for carrying out aggression in the Western Hemisphere. Given these conditions and constraints, the more specific questions to be examined in this paper are the following: (1) short of those actions which would clearly provoke another military confrontation with the United States, what are the alternative courses for the Soviet Union with respect to making Cuba either a more useful or a less burdensome ally? (2) What do the alternative Soviet courses of action imply for the political and economic life of the Castro regime?

B 9

Armitage, James H. (LCdr., USN) and Tolcott, Martin A., "Manpower Studies at the Center for Naval Analyses," (Published as part of "Manpower Research in the Defense Context," Proceedings of a Conference under the aegis of the NATO Scientific Affairs Committee, London, 14-18 Aug 1967, edited by N. A. B. Wilson, American Elsevier Publishing Co., Inc., New York, 1969)

This paper describes, first, some of CNA's work in making a survey of manpower utilization studies, as evaluated against a concept of how such studies should be contributing to the manpower planning process; second, some of the concepts of manpower planning in industry and other government agencies, including the other services and how they are applicable to Navy manpower planning problems; and third, a description of a way of ordering information by means of which the Navy's manpower planning process might be improved.

B 10

Morton, Anton S., "Manpower Studies at the Institute of Naval Studies 1963-1966," (Published as part of "Manpower Research in the Defense Context," Proceedings of a Conference under the aegis of the NATO Scientific Affairs Committee, London, 14-18 Aug 1967, edited by N. A. B. Wilson, American Elsevier Publishing Co., Inc., New York, 1969)

Paper reporting on studies carried out in the first three years of the Manning Study of the Institute of Naval Studies, of the Center for Naval Analyses.

B 11

Breckner, Norman V. and Noah, Joseph W., "Costing of Systems," (Published as part of "Defense Management," edited by Stephen Enke, Prentice-Hall, Inc., 1967)

> Two principal dimensions of system cost analysis are addressed. First, the comparative analysis of alternative systems requires a method of structuring the synthesizing cost estimates in order to reveal both the total costs of achieving effectiveness and the significant differences to be found among various force mixes. Second, the methods of estimating particular costs are evolving from a history of inappropriate or inaccessible data and great uncertainty concerning the time and cost of ultimately achieving demonstrated capability. Several important avenues for further work are discussed.

B 12

Coile, Russell C., "Educational Planning in Developing Countries," (Published as part of "Recherche Operationnelle et Problemes du Tiers-Monde," Dunod, Paris, 1964; Presented at the Symposium on the Possibilities of Operational Research in Developing Countries, Paris, France, Jun 1963)

> Operational research studies may be able to contribute to the quantitative analysis of the requirements for the national educational system as well as to the planning of optimum utilization of educational resources. Selective admission schemes, scholarships, types and locations of educational institutions, courses of study, student quotas, etc., should all be studies with the overall national objectives in mind so that the education and training portions of a five-year plan directly support the personnel requirements generated by projects in agriculture, industry, engineering and government.

B 13

"Studies Prepared for The President's Commission on an All-Volunteer Armed Force," Volumes I and II, Nov 1970 (Available at the Government Printing Office)

Part I — Military Personnel Requirements
Study 1

Forst, Brian E. and Oi, Walter Y.,* "Manpower and Budgetary Implications of Ending Conscription," 90 pp.

> In order to develop reliable estimates of manpower requirements and defense budgets for military personnel under both continued draft and all-volunteer environments, an analytic model is constructed. First,

*University of Rochester.

four alternative force strength objectives for the years ahead are set forth. Then, the derivation of turnover, training and travel cost parameters, supply surves, and transition strength objectives employed in the projections are described. Finally, the implications of the projections generated by the model are reviewed. A technical appendix is also included for the reader who is interested in additional details of the model.

Study 2

Sullivan, John A., "Qualitative Requirements of the Armed Forces," 56 pp.

> Estimates of the probable mix of mental abilities possessed by those individuals who are expected to volunteer for the Armed Forces in the absence of a draft are calculated. Finally, attention is directed to the differentials in performance, formal training, and disciplinary problems of recruits of varying measured mental-capabilities.

Study 3

Reaume, David M. and Oi, Walter Y.,* "Educational Attainment of Military and Civilian Labor Forces," 23 pp.,

> The cumulative percentage distribution of enlisted men and officers, classified by years of school completed, and the combined educational distributions of all uniformed personnel are presented. The educational distribution of the civilian male labor force is compared with the Armed Forces.

Study 4

O'Neill, David M., "Determinants of Labor Turnover Costs in the Military" 43 pp.,

> For Abstract see CRC 170

Part II — Supply of Personnel to the Military
Study 2

Gray, Burton C., "Supply of First-Term Military Enlistees," 40 pp.

> This study examines the change in the number of enlistments in the military services resulting from a given change in military pay. The effect of pay is isolated from all other factors which influence the decisions of men faced with the choice of enlisting or remaining civilians.

Study 8

Grubert, Harry and Weiher, Rodney F., "Navy Re-enlistments: The Role of Pay and Draft Pressure," 19 pp.

> The main purpose of this study is to estimate the response of first-term Navy reenlistments to changes in second-term pay.

B 13—Continued

An attempt is made to find out how much reenlistments are affected by the degree to which men making their reenlistment decisions were draft motivated when first entering. The conclusions are based on the observed behavior in FY 68 of men with varying levels of second-term pay they can expect as well as differences in civilian opportunities and amount of draft motivation. The first section of the paper explains the framework of the analysis and the equations to be estimated. This is followed by a discussion of data sources and the construction of the variables. The third section presents the empirical results including a brief analysis of non-white reenlistments.

Part III — Historical, Political and Social Research

Study 1

Rafuse, John L., "United States' Experience 9with Volunteer and Conscript Forces," 46 pp.

The polemics of conscription in America abound with references to history and tradition, but present little data or analysis. This study examines American history with special regard for military manpower recruitment practices. One purpose of the study is to provide a historical survey of conscription in America and to convey some of the contextual flavor of the past debates. The second and principal purpose is to contrast the debates with factual data to permit judgment on the credibility of the debates, and on the extent to which conscription is or is not in the American tradition.

Study 2

McConnell, James M., "European Experience with Volunteer and Conscript Forces," 190 pp.

The purpose of this study is to examine European cases to find what lessons, if any, they offer for the United States. Of primary relevance to America is the European experience with volunteer and conscript standing armies and their effect upon domestic politics.

Study 5

Horack, Jessie and Wilson, Jr., Desmond P., "Military Recruitment and Militarism in Latin America," 21 pp.

The purpose of this study is to examine the Latin American experience for possible insights and implications for the military manpower recruitment problem in the United States. Two objectives are pursued. The first objective is to assemble some of the basic information on Latin American military establishments—particularly their size and methods of recruitment. The second objective is to examine the frequently-made assertion about Latin America that an all-volunteer military is more prone to interventions in national political life than is a military establishment which relies on conscripts.

Study 7

Horack, Jessie and Wilson, Jr., Desmond P., "Military Experience as a Determinant of Veteran's Attitudes," 27 pp.

A shift from conscription to voluntarism is expected to change the size and perhaps slightly the social composition of the veteran population. It is the objective of this study to determine whether or not important social or political consequences might accompany changes in the flow of veteran citizens who are presumed to benefit society as a result of their military experience. The approach to the problem is direct and empirical. It consists of an analysis of existing national opinion surveys to determine whether or not veterans possess significantly different opinions than non-veterans on matters of contemporary debate.

Study 8

Kassing, David B., "Military Experience as a Determinant of Veterans' Earnings," 22 pp.

The purpose of this study is to investigate how an individual's civilian earnings are affected by military service. It is based on a number of recent studies which present evidence bearing on this issue.

Part IV — Other Studies

Study 3

Lando, Mordechai, "Health Services in the All-Volunteer Armed Force," 45 pp.

For abstract see PP 60

B 14

Athay, Robert E., "An Economic Appraisal of Soviet Merchant Shipping Policy," Oct 1971, (Published by the University of North Carolina Press, 1971)

This book assesses the economic efficiency of the heavy commitment of Soviet resources to the merchant fleet in recent years. The analysis compares the real benefit obtained from ocean shipping to the real cost incurred. No attempt is

B 14 — Continued

made to demonstrate whether the rate of investment has been optimal; but only to show if such investments have involved a significant economic return. The economic benefits arising from the expansion of the Soviet merchant fleet, which are measured primarily in terms of the contribution of the fleet to the country's balance of payments, appear to have provided a clear margin over the economic costs of the program.

B 15

Halpern, Abraham M., "Communist China as a Model of Development," 15 pp., (To be published as part of "Protagonist of Change," edited by Professor A. A. Said, American University, Prentice-Hall, Sep 1970)

Chinese Communists regard themselves as a model for others to follow. This paper discusses the character of the model and the audiences to which it is recommended. What the movement aims to do and what it does not aim to do is specified.

B 16

Breckner, Norman V., Friedheim, Robert L., Heselton, Jr., Leslie R., Mason, Leo S., Schmid, Stuart G., and Simmons, Robert H., "The Navy and the Common Sea," 1970, (Published by the Government Printing Office)

This book reports the results of a study on how ocean programs, non-defense activities off U.S. shores, possible changes in the status of the sea affect the Navy's role in national security. Three interactions among those who use the ocean or manage marine affairs are discussed. The first interaction includes relationships between the Navy's oceanographic programs and programs of other Federal agencies that study, explore, or develop the ocean. The second includes interactions between Naval and other U.S. activities that make common use of offshore spaces and resources. The third interaction is among sovereign states concerning jurisdiction of, or control of access to, ocean regions and resources.

B 17

Schick, Jack M., "The Berlin Crisis 1958-1962," 266 pp., 1971, University of Pennsylvania Press

This book traces the East-West pattern of impatient negotiation followed by military posturing and pressuring. It sheds new light on Dulles' intellectualized diplomacy, Kennedy's cautiously balanced Berlin strategy, and Ulbricht's urgent gamble on the Berlin Wall. Against a detailed background of diplomat verbiage and tension-ridden events it points up the blind convictions and dangerous misunderstandings on both sides

that inevitably led to each incident in the continual crisis and ultimately brought us to the impasse that still remains.

B 18

Halpern, Abraham M., "The PRC's Post-Cultural Revolution Foreign Policy," 23 pp., Oct 1971, (Published as a chapter of "Sino-American Relations, 1949-71," edited by Rogerich MacFarquhar, Praeger, 1972)

This paper discusses the foreign policy of the Peoples Republic of China from 1968-1971. It asks three questions: What has been the PRC's recent analysis of the world distribution of power? How has the PRC seen its own role in this kind of world? What interest has the PRC tried to realize, and what resources has it had available? In exploring the answers to these questions, this paper seeks to discover if there is an underlying rationale or strategy behind PRC foreign policy in the current period.

B 19

Coile, Russell C., "Magnetostriction Resonant Frequencies," (Published in Electronics Vol. 20, No. 9, Sep 1947; Also published as a part of "Ultrasonics" by Benson Carlin, McGraw-Hill, New York, 1949)

Magnetostriction oscillators have been widely used in many electronic applications, particularly in underwater sound, since Professor George Washington Pierce of Harvard first reported on his research in 1927. These oscillators have their frequency controlled by a magnetostrictive rod of nickel, Monel metal, Invar, Nichrome, Stoic metal or other nickel alloys. When a magnetostrictive rod or tube is placed in an alternating magnetic field and clamped or pivoted at the center of the rod, the resonant frequency of the rod is given by $f=v/sl$, where f is the resonant frequency in kilocycles per second, v is the velocity of sound in the rod in centimeters per second and l is the length of the rod in centimeters. A nomograph has been designed for quick calculation of magnetostriction resonant frequencies.

B 20

Breckner, Norman V. and Newlon, Daniel H., "The Oil Security System—An Import Strategy for Achieving Oil Security and Reducing Oil Prices," 112 pp., Lexington Books, D. C. Heath and Company, 1975

This book is an extension of earlier work published in CNA Research Contribution 255. The operation of the Oil Security System is simulated and estimates are made of the benefits of this approach over an import quota or a tariff. Potential administrative problems are identified through detailed illustrations and solutions to these problems are suggested.

SECTION III

I. PAPERS PRESENTED AT PROFESSIONAL MEETINGS

P 1001

Baumgarten, Erwin and Davies, T. D. (RAdm., USN), "Intercontinental Transport Problems," 12 Aug 1965, (Published in a summary included in the Proceedings of the 1965 Annual Meeting of the German Operations Research Society, Oct 1965)

During the last five years, deployment of sizable military forces overseas on short notice has emerged as a major strategic task of the United States. This paper reviews the evolution of rapid deployment concepts and systems from the point of view of the systems analyst.

P 1002

Buchanan, John E. and Chiodo, Ronald A., "An Example of the Relationships Between the Uses and the Development of Cost Estimating Relationships," 24 Mar 1969, (Published in the Proceedings of the 4th Annual Department of Defense Cost Research Symposium, Mar 1969)

Predicting cost as a function of certain explanatory variables and analyzing how cost varies with changes in given variables are two objectives of cost analysis. Here, the first objective is termed prediction and the second objective, structural analysis. Different criteria should be used in the derivation of cost estimating relationships for these objectives. Not considering the link between the uses of CER's and their development may result in incorrect answers, misleading concepts, or both.

P 1003

Coyle, John P., "Prudence in Risk-Decision Making," (Presented at Operations Research Society of America Meeting, May 1962; See also Prudence II, P 1008)

This paper is intended to explore the responsibility of staffs, consultants and the community at large to decision makers empowered to undertake fateful commitments. When risk decisions are made responsibly, motives include survival as well as success. Observations are summarized of several activities which are distinguished both by uncertainty and in having survival as a characteristic outcome. From analogy with biological communities, the stock market, and the gambling casino, conclusions that seem germane to problems of national policy decision in the face of uncertainty are drawn.

P 1004

Steinhardt, Jacinto, "Operations Research," (Presented at the New York Meeting of the Institute of Mathematical Statistics and the American Statistical Association, Dec 1947)

Discussion of the scope and methods of operations research during World War II.

P 1005

Coile, Russell C., "Application of Concept Coordination to Document Control," (Presented at 132nd Meeting of the American Chemical Society, New York, Sep 10, 1957 at the Symposium on Mechanized Data Handling)

An organization considering the introduction of mechanized data handling for its literature will do considerable research on its operations before making a decision. Mechanization, *per se,* as illustrated by the Harwell punched card indexing experiment and the Department of Agriculture Library trials of the "Rapid Selector" may not solve any of the problems of a particular library. Thus, operations research on the library should examine the needs of the organization, the librarians and the users. The optimum mechanization system should be useful for document control as well as for information retrieval. An application of concept coordination using computer facilities is suggested for research literature collections.

P 1006

Frisch, Franz A. P. and Weir, W. Donald, "Analysis of Mission and Design Concepts for a Logistic Ship," 24 Jun 1966, (Published in Papers—7th Annual Meeting, Transportation Research Forum, Nov 1966, Richard B. Cross Co., Oxford, Indiana; Presented at the NATO Advisory Panel on Operational Research Meeting on the Analysis of Systems of Military Transportation, Defense Operational Analysis Establishment, Oxford, England, Jul 1966)

Methods being used by the USN in acquiring the Fast Deployment Logistic (FDL) Ship differ from previous practices in several respects. The methods include program phases known as concept formulation and contract definition. A major objective of the former is determination of system mission and performance envelopes. System studies which addressed problems of defining such envelopes for the FDL ship were performed by the Center for Naval Analyses. A

P 1006—Continued

description of the analytical approach employed by CNA is presented here to provide a comprehensive view of the overall structuring of an analysis of this type and the interrelationships among its essential elements.

P 1007

Baumgarten, Erwin, "Reliability and Maintenance," 25 Jan 1962, (Presented at Military Logistics Research Conference, Supreme Headquarters Allied Powers Europe, Air Defense Technical Center (SADTC), 22 Aug 1962)

Under which specific conditions are preventive measures advantageous? This question is a typical operations research problem. There are several alternatives: trouble shooting, scheduled maintenance, and institution of a run-in period. Each alternative has advantages and disadvantages. This paper discusses the solution of this problem. A mathematical model of the failure phenomena is developed and practical maintenance rules are derived from the model.

P 1008

Coyle, John P., "Prudence II—An Analysis of Measures of Effectiveness Related to Survival," 18 Mar 1963 (Published in Proceedings of the Tripartite Symposium on Military Operations Research, Jun 1963)

An earlier, more general paper, entitled "Prudence in Risk-Decision Making" (P 1003) makes the distinction between the evaluation criteria appropriate, separately, for the venturer committed to an enterprise and the prudential policy which values an individual venture within the context of a portfolio of risks. This paper investigates a naive analytical model in an attempt to derive more explicit prudential measures of effectiveness than the purely descriptive characteristics noted in the earlier paper.

P 1009

Coyle, John P., "Qualitative Factors in the Choice of a Weapons Mix for a Strategic Deterrent Posture," (Presented at the Operations Research Society of America Meeting, Fall 1961)

Discusses the problem of allocation among alternative strategic weapon systems. Demonstrates that much of the difficulty we have had with this problem has arisen neither from lack of quantitative analysis nor from a pusillanimous hesitancy on the part of decision makers to make up their minds. It is suggested rather that it is due to our failure to distinguish carefully enough between questions we must decide and questions that are better left unanswered.

P 1010

Engel, Joseph E., Glazer, Herbert, and Steinhardt, Jacinto, "The Selection of Cargo for Air Transport," (Reprint by Richard Clay and Company, Ltd., Bungay, Suffolk, Great Britain; Presented at the International Federation of Operations Research Societies Conference, Sep 1960)

Air freight is now used regularly in industry and the military, usually because of its speed and cargo protection. However, the expense of airlift frequently leads to the use of slower, cheaper transport such as ocean freight. This paper describes a procedure which may serve as an economic basis for choosing between resupply of an inventory by air as compared with ocean freight.

P 1011

Camp, Glen D., "Operations Research: A Comprehensive Scientific Aid to Executive Decision," (Lecture delivered at the U.S. Naval Medical Research Institute, Bethesda, Maryland, 16 Mar 1951)

Discusses operations research: what it is; how it functions; is it new; and what further achievements may be expected.

P 1012

Barfoot, Charles B., "Stochastic Duels in which Each Contestant's Shots Form a Markov Chain," (Published in the Proceedings of the 5th International Conference on Operation Research, Jun 1969, available from Tavistock Publications Limited; Presented at the Operations Research Society of America/The Institute of Management Sciences Joint Meeting, San Francisco, California, May 1968)

This paper presents some further developments in the theory of stochastic duels for situations in which the shots by each contestant form a Markov chain with constant transition probabilities. In these duels the two contestants, A and B, are assumed to have an unlimited supply of ammunition, to fire at constant intervals of time, a and b, respectively, and to duel until one is killed. For these conditions, the probability P(A) of contestant A winning the duel is given for the case where (1) both contestants begin with unloaded weapons and have tactical equity, and (2) contestant A has the advantage of surprise and can fire y rounds at B before the two-sided duel begins, where y is a random variable. Potential applications of models of this type to duels between weapons are also illustrated, and further areas for research are discussed.

P 1013
DiBona, Charles J., "Trends in Research and Development," (Presented at 22nd Military Operations Research Society Meeting, Naval Post Graduate School, Dec 1968)

The evidence suggests that in our Research and Development program there has been less exploration of alternatives and higher expenditures during the past 10 or 15 years. In this paper, some suggestions on how this trend can be changed are made.

P 1014
Marbury, Fendall, "The Vertical Mobility of Deep-Diving Submarines," (Published in Transactions of the Ocean Science and Ocean Engineering Conference, Jun 1965)

In small submarines designed to dive deep, energy required for diving and rising is an appreciable fraction of their total supplies, hence worthy of attention. Energy demand for vertical motion consists of two parts: work against hydrodynamic drag, and work to offset the difference in compressibility between sea water and submarine. Steep dive angles are recommended to save propulsion energy. Work done to offset compressibility is recovered as vertical propulsion. Nevertheless, the amount so done should be minimized, in order to hold down energy losses entailed in doing it. Energy for vertical motion can be carried in chemical or mechanical accumulators, or a ballast to be dropped. The two can be compared by means of specific potential, defined as the capability of an accumulator in foot-pounds divided by its weight in pounds. For ballast, specific potential is potential energy per pound, measured above bottom, and is numerically equal to the water depth. Other suitable accumulators have constant specific potentials of 10,000.

P 1015
Morton, Anton S. and Fisher, Franklin M.,* "The Cost Effectiveness of Reenlistment Incentives in the Navy," (Presented at 28th Annual Meeting, Operations Research Society of America, Nov 1965)

This paper describes tthe methodology developed at the Institute of Naval Studies, Center for Naval Analyses, to estimate cost/effectiveness of reenlistment incentives.

*Department of Economics, Massachusetts Institute of Technology.

P 1016
Coile, Russell C., "Operations Research," (Presented at the 6th New England Quality Control Conference of the American Society for Quality Control, Worcester Massachusetts, Oct 3, 1952)

During World War II, mathematicians, physicists, chemists, biologists, etc., were asked by the military to carry out research on various problems of operations, intelligence and logistics. This application of the scientific method to war time problems would now appear to have many similar applications in industry. Quality control statisticians should be on the alert to employ these operations research principles and broaden the service they supply to management.

P 1017
Augusta, Joseph H. and Jenner, Richard A., "The Marine Corps Cost Model," (Published in DoD 4th Annual Cost Research Symposium Proceedings, Mar 1969)

This paper describes how input-output can be used as a cost model. It presents the structure and sample results for a model of a simplified military organization.

P 1018
Augusta, Joseph H., Jenner, Richard A., and Tullier, Pierre M., "Decision Models for Maintenance and Logistic Planning in Combat," (Published in the Proceedings of the 22nd Meeting of the Military Operations Research Society, Dec 1968)

In this paper the authors show that effective maintenance planning requires (a) an accurate projection of future maintenance needs and (b) a forecast of the secondary effects on maintenance stemming from changes in maintenance needs. A model is presented which handles the first problem by means of a set of stochastic matrices and the second by input-output analysis.

P 1019
Augusta, Joseph H. and Jenner, Richard A., "Input-Output as an Aid to Military Decision Making," (Presented at the 34th National Meeting, Operations Research Society of America, Nov 1967; Published in Bulletin of the Operations Research Society of America, Vol. 16, Supplement 2, Fall 1968)

This paper briefly describes how input-output analysis can be used to account for the interrelationships in a military organization that complicate estimating the resource implications of alternative forces.

P 1020
Baumgarten, Erwin, "Operational Data Requirements for ASW Studies," (Published in the Proceedings of the NATO Science Committee, Advisory Panel on Operations Research Meeting, 27 Jun 1966)

P 1020–Continued

The first part of this paper outlines the general approach to force planning problems which has been followed in CNA in several of its major studies. It serves as background for the second part which identifies the principal types of operational data which are required as inputs for ASW cost-effectiveness analyses and covers data requirements in the ASW weapon field in some detail.

P 1021

O'Donnell, Frank H., "The Air Launched Ordnance Study Model," (Published in the Proceedings of the 2nd Symposium on Increased Survivability of Aircraft, Department of Defense/RAND Corporation, 16-20 Feb 1970)

The Air Launched Ordnance Study (ALORS) Model compares various tactics—force and ordnance mixes. The model employs expected value rather than Monte Carlo methods and is highly parametric. Tactical allocations of aircraft may change throughout the war, as allowed by changes in attrition due to interceptors, for example. Enemy surface to air missile capabilities may also be reduced due to friendly air attack. Finally the model may be run in a requirements mode. A specific level of target destruction can be specified and the model can calculate aircraft and ordnance assets needed to achieve it.

P 1022

Coile, Russell C., "Financial Planning of a Professional Society Meeting," (Presented at the 22nd National Meeting, Operations Research Society of America, 8 Nov 1962)

In order to plan for the facilities and determine the registration fees to be charged to cover the costs of the meeting, a detailed examination of the 20 national meetings of ORSA already held was undertaken. This paper summarizes available data on registration at previous meetings, proportion of members, non-members and students attending, location of meetings, registration fees charged, numbers of invited and contributed papers, and costs and attendance at meeting mixers, luncheons and dinners.

P 1023

Coile, Russell C., "An Example of Optimum Distribution of Effort," (Presented at the 2nd Annual Meeting, Operations Research Society of America, 22 May 1954)

An examination has been made of the distribution of initial investment in the construction of a UHF TV station among the major transmitting components; TV transmitter, tower and UHF antenna. Current cost figures have been used in a determination of the best balance of expenditures to obtain the maximum TV coverage for the minimum investment.

P 1024

Coile, Russell C., "A Mechanized Library," (Delivered on 18 Jul 1951 during a broadcast of the General Electric Science Forum program over radio station WGY, Schenectady, New York)

Discussion of library machines being developed to aid modern libraries in the storage and subsequent searching for information.

P 1025

Breckner, Norman V., "Some Dimensions of Defense Interest in the Legal Delimitations of the Continental Shelf," (Published in "National Policy Recommendations," Proceedings of the 4th Annual Conference of the Law of the Sea Institute, Jun 1969)

There are several interrelated issues of U.S. defense interest in the question of selecting a relatively wide or relatively narrow legal continental shelf around the world. Some are: differences among naval powers in frequency of use of the seabed and in regions of preferred use; the relative surety of a coastal State's naval access to its own shelf areas and to the deep seabed covered by the concept of freedom of the seas, compared to the somewhat more uncertain access to the seabed within another State's shelf delimitation; the possibility that different military employments of the deep seabed will be affected differently by the deep-seabed legal regime that ultimately evolves from managing non-defense resources; the terms, if any, under which the U.S. Navy might be at a relative disadvantage if seabed areas off U.S. shores are not under national jurisdiction for purposes of exploiting resources.

P 1026

Coile, Russell C., "A Library Machine for Chemical Literature," (Presented at the 118th National Meeting of the American Chemical Society at Chicago, Illinois, Sep 1950)

A library machine using microfilm is proposed for use with the million abstracts now available for chemists. The problems of information retrieval have not received as much attention as those of searching, translating, abstracting and editing chemical literature. However, a library machine based on the research by Dr. Vannevar Bush at MIT on his "Rapid Selector" may assist research libraries.

P 1027

Friedheim, Robert L., "The Marine Commission's Deep-Seabed Proposals—A Political Analysis," (Published in "National Policy Recommendations," Proceedings of the 4th Annual Conference of the Law of the Sea Institute, Jun 1969)

The Marine Science Commission's proposals for the deep-seabed must be evaluated on a number of criteria. But the one criterion that probably will be dominant in the action phase is the political. Thus the Commission proposal for an International Registry for the deep-seabed must be examined as a political document. There are two ways of doing this: First, it can be considered as an example of political theory or theories; the author has done this to some extent in another paper (A 1012). Second, it could be thought of as a proposal which fits the opinions of the requisite number of States to be adopted or fail of adoption. A little of both methods are used in this paper.

P 1028

Heselton, Jr., Leslie R., "A Framework Towards a Seabed Regime," (Published in "National Policy Recommendations," Proceedings of the 4th Annual Conference of the Law of the Sea Institute, Jun 1969)

Submits a broad framework on which to build a precise set of rules to govern the exploitation of the resources of the seabed and subsoil of both the continental shelf and the deep-seabed. The framework is a beginning not a final regime.

P 1029

Wilson, Jr., Desmond P., "Alternative Futures in the Cuban Revolution," 22 pp., Oct 1970, (Presented at the Southern Political Science Association Fall Meeting, 7 Nov 1970; Published in ORBIS Vol. XV, No. 3, Fall 1971)

This paper discusses three options for future Cuban economic, political and military affiliation. The first one is essentially the present situation—a continuation of a highly authoritarian government which labels itself communist and maintains close ties with the Soviet Union. The second alternative future is a return of Cuba to U.S. hegemony. The third option is the evolution of Cuba toward some greater international autonomy sometimes referred to as a "Yugoslavia in the Caribbean." Historical evidence points in the direction of continued ties with the Soviet Union and because of Soviet and U.S. competition the Cuban Revolution will continue to be an international concern with global and not simply regional implications.

P 1030

Blechman, Barry M., "The Consequences of the Israeli Reprisals on Patterns of Interaction Between Israel and the Neighboring Arab Nations," 26 pp., (Presented at the 66th Annual Meeting of the American Political Science Association, Sep 1970)

This analysis is restricted to three of the most basic motivations for reprisals, to compel target nations to take positive steps to stop private infiltration; to take steps to stop actively sponsoring hostilities with Israel; and, to compel target governments to improve general relations with Israel. The analysis will attempt to measure the degree to which the reprisals satisfied these motivating considerations.

P 1031

Schwartz, Lawrence E., "Application of Nonlinear Programming and Bayesian Statistics to the Theory of the Firm," (Presented at the 6th International Symposium on Mathematical Programming, Princeton University, 15 Aug 1967)

In the primal, optimal input and output levels of an n-product monopolistic firm, operating in the short run, are to be obtained. The short run is a period short enough so that at least some of the firm's factors of production are fixed and indivisible. The firm will be assumed to maximize some utility function belonging to its decision-maker, subject to production function constraints on resource use. Production is to be assumed that all products are produced in the same plant so that there are interactions in the decisions to allocate resources among the different products. These products will, in addition, be assumed to be sold in markets where demand is uncertain.

P 1032

Schwartz, Lawrence E., "Large Step Gradient Methods for Decomposable Nonlinear Programming Problems," (Presented at the Conference on Optimization, University of Keele, England, 25 Mar 1968; Published in "Optimization" edited by R. Hetcher, Academic Press, 1969)

Several new algorithms for solving large-scale nonlinear programming problems having a special structure are presented. These problems occur in economics and in certain related contexts. The constraint set in problems of the type to be considered contains both nonlinear and linear functions, the linear portion of the constraint matrices having the usual block diagonal or staircase structure. Many otherwise independent linear blocks are linked together by a relatively small number of nonlinear connecting relations.

PAPERS

P 1033

Schwartz, Lawrence E., "An Inventory Model for Multistage Production Processes," (Presented at the Joint Meeting of The Institute of Management Sciences and the Operations Research Society of America, 1 May 1968)

This paper develops a model to determine the optimal sizes of the inventories that a firm or government agency having a multi-stage production process should maintain. A subsidiary aim is to determine a set of transfer prices so that rational tradeoffs can be made between inventories of spares and semi-finished parts on the one hand and stocks of capital and labor skills on the other. The model thus allows a firm's management to take advantage of both the informational and the incentive effects of decentralized markets. These transfer prices also allow resource allocations and reallocations to be made without resolving the model each time for new optimal values.

P 1034

Broussalian, Vartkes L., "The Present Value Criterion in Military Investments," 10 pp., 21 Sep 1966, (Presented at the Operations Research Society of America Meeting, Oct 1966)

This paper discusses the reasons why the present value criterion, to which logically discounting leads up, is not appropriate for nonmarketable investment decisions, of which a substantial proportion of military systems analyses constitutes a sub-class.

P 1035

Buc, Bernard J., "Some Analytical Elements of Fleet Air Defense Planning," 35 pp., Nov 1971, (Presented to the Chief of Naval Research, Ministry of Defense, Whitehall, London, Nov 1971)

Advancement in the technology of surface-to-air missiles has led to the recent development of a much more sophisticated threat, the anti-ship cruise missile, which can be launched by aircraft, surface ships, or submarines and guided to its target by either autonomous or linked guidance in a wide variety of altitude, speed, range combinations. Responses to such a threat have resulted in a wide spectrum of prospective systems including electronic warfare to aid in the detection, classification and confusion of the missile's platform and guidance system. The relative expense and capabilities of these systems, however, preclude a simple choice and necessitate some form of analytical treatment to aid the selection from amongst alternatives. This paper considers some of the elements of such an analysis.

P 1036

Cotton, James L., Karas, Robert E. (Cdr., USN), and Linnell, Richard D., "U.S. Navy Ship Automation," 27 pp., Feb 1972, (Presented at the 3rd Ship Control Systems Symposium at Foxhill, Bath, U.K., 26-28 Sep 1972)

Use of automation can reduce the manning of future design U.S. Navy ships by about 30 percent immediately and by 40 percent in the 1980s. The technology is available now, but changes of the Navy management organization and select changes in Navy operative directives and procedures must be made if use of this technology is to provide real reductions of manning in future new-construction ships.

P 1037

Butterly, Peter J., "Position Finding for Multiple Indistinguishable Signal Sources," 20 pp., Jul 1973, (Published as (CNA)1301-73; Presented at the 32nd Military Operations Research Symposium)

In this paper the general problem of utilizing position-related observations to determine source position in the presence of a multiplicity of indistinguishable signal sources is considered from a Bayesian viewpoint. The treatment is directed towards ascertaining what is known subsequent to the observations and consists mainly of the derivation of procedures to provide this knowledge. Results previously obtained in a comparable treatment of the single source problem are incorporated in these procedures.

P 1038

Gray, Burton C., "A Military Manpower Projection and Simulation Model," 24 pp., Apr 1973, (Published as (CNA)804-73; Published in the Proceedings of the International Congress on a Programming Language (APL Congress 73) Aug 1973)

The Enlisted Personnel Projection and Simulation Model (EPPSM) has been developed for the Navy as an aid to manpower planners and analysts concerned with projecting future manpower structures. The paper includes the details of the model theory and interpretation and a description of the programming environment, logic, and characteristics of the implementation, together with an indication of the procedure to change and augment it.

P 1039

Borgstrom, Robert E. (DP2, USN), "Non-Spatial Interaction; An Alternative Approach to Transportation Geography," 6 pp., Jan 1973, (Presented at the Annual Meeting of the Middle Atlantic Division of the Association of American Geographers, Jan 1973)

P 1039 — Continued

The geography of passenger transportation has long been biased by the presumption that a functional relationship exists between measurable distances and the interaction of objects with other places. Consequently, and with few exceptions, scientists of spatial interaction have viewed transportation systems as networks of conduits through which inanimate objects stochastically flow. In doing so they have assumed that it is the pair of cities which interact, and they have forgotten that it is a population of individual decision makers within each city who are somehow motivated to travel from place to place. Viewing transportation geography in this way, an alternative methodology is to consider not the geometry of sites and routes but to attempt an understanding of socio-cultural associations, the basis of what may be called, non-spatial interaction.

P 1040

Kozman, Theodore A. and Forrester, J. H.,* "Pulsatile Flow in a Modeled Stenosis," (Presented at the 26th Annual Conference on Engineering in Medicine and Biology, Sep-Oct 1973)

A theoretical investigation of pulsatile laminar, axisymmmetric flow of of incompressible, Newtonian fluid through a rigid converging-diverging tube is undertaken. Through this study it is hoped that an insight into the differences between the steady state and time dependent shearing stess, pressure, and separation region will be gained. This paper briefly discusses the theoretical fomulation of the problem and gives an example of the type of results which can be obtained from such a solution.

Engineering Science and Mechanics Department, University of Tennessee.

P 1041

Anger, Thomas E., "Some Critical Thoughts on Defense Resource Planning and the Role of Analysis," 21 pp., 28 Jan 1974 (Published as Memorandum (CNA)155-74; presented at 31st Military Operations Research Symposium, Jun 1973)

This paper first discusses defense resource planning under McNamara and shows how his system worked. It then shows how the Laird system worked, and compares the major differences between the McNamara and Laird systems. Next, it highlights the role of the participants in the Laird system and the kinds of analysis used in the key decision documents in the system. Finally, it summarizes some major conclusions to be drawn from this history of defense resource planning.

P 1042

Barfoot, C. Bernard, "Some Anti-Armor Models Used in U.S. Marine Corps Planning Studies," 19 pp., Aug 1974 (Presented at the Conference on Modeling Land Battle Systems for Military Planning, Munich, Germany, 26-30 Aug 1974)

This paper presents some analytic models of combat that have been used in planning studies by Headquarters, U.S. Marine Corps, in support of decisions regarding the procurement of alternative anti-armor weapons.

P 1043

Forst, Brian E., "Quantifying the Patient's Preferences," 19 pp., Oct 1972 (Presented at the conference conducted by Health Services Research, Tucson, Arizona, Oct 1972)

This paper describes a methodology for depicting, in an explicit, quantitative statement, an individual's tastes for the elements that comprise "health status." This quantitative expression is referred to interchangeably as the "preference function" or "disutility function."

P 1044

Moore, Arnold B., "Experience with the Planning, Programming and Budgeting System in the Federal Government," 9 pp., Apr 1969 (Address presented at the University of Chicago Management Conference)

Discusses the primary features of the PPB System; evaluates the performance of the system in the Defense Department; and points out some major problems affecting the use of PPB and economic analysis as a basis for planning in the Federal Government.

SECTION III

J. OTHER CENTER FOR NAVAL ANALYSES PUBLICATIONS

M 1001

Averill, Felix E., "The Development of the Center for Naval Analyses," 1968

This brochure presents information about the Center for Naval Analyses. It includes its missions, responsibilities, structure and a brief review of its history and that of its predecessor organizations.

M 1003

Coyle, John P., "Contribution of Public Policy and Long-Range Plans to Urban Evolution," (Reprinted by Richard Clay and Company, Ltd., Bungay, Suffolk, Great Britain)

A concept is developed describing the evolution of the city as an intricate teleological mechanism which generates its objectives intrinsically. In the essentially political environment in which broader policy decisions are made it is observed that the appreciation of quantitative analysis tends to be less responsible than in an executive organization. Of equal importance, therefore, to the competence of the quantitative basis offered for decisions is the organization of large and fateful programs into an evolving sequence or pattern of decisions allowing feedbacks from experience to validate the process on its own terms. As land-use patterns are determined largely by the peculiarities of the competitive market, Government land-use control can be achieved only through calculated interference with this market. Attempts at regimentation into a preconceived ultimate use are of questionable value. Not only are government powers too limited, but controls act so slowly that the ultimate conception is outdated before it takes effect. Regulation should rather seek to exploit the operation of the market as an arbitration device, which can automatically seek socially optimum land-use patterns.

M 1004

"Operations Evaluation Group, 20th Anniversary Conference on Operations Research," 134 pp., May 1962, AD 715 685

The Chief of Naval Research called the conference on operations research in honor of the twentieth anniversary of the Operations Evaluation Group. The conference had two purposes; first, to survey the past accomplishments, present activities, and future plans of military operations research groups in the United States and abroad; and, second, to hear and discuss papers on new techniques and unsolved problems in operations research, education for operations research and new fields of application, and current ideas regarding the organization and direction of military operations research groups.

M 1005

O'Keefe, William F., "The Center for Naval Analyses in 1969," 21 pp.

This brochure presents the Center's objectives, organizations, methods of formulating the study program, highlights of the 1969 program, plans and future programs, and the Policy Council. It reviews managerial practices and the concept underlying a not-for-profit organization.

M 1006

Miller, Melvin D., "A Kinematic Solution to Optimizing the Design of Intercept Barriers," 4 Jun 1967, (A thesis submitted to George Washington University, School of Engineering and Applied Science)

The purpose of this thesis is to derive analytically a set of decision aids which will assist a Naval commander in deploying his available forces in the most effective intercept barrier for a given tactical situation. A barrier is the disposition of units placed so that an enemy must penetrate the barrier to reach an objective. The barrier commander will attempt to thwart the enemy by using the barrier units to intercept all penetration attempts. To achieve interception, the barrier commander must receive timely notice of the position and intentions of penetrators, and must have an interceptor in a favorable position to close the enemy. This is a basic problem for the Naval commander faced with the task of administering a blockade or quarantine operation. It is the responsibility of the commander to manage his forces so that they are used efficiently to achieve his objectives.

M 1008

Karns, Charles W., "An Application of Lanchester's Equations to Amphibious Assaults," 19 pp., 31 Dec 1953, Operations Research Group Study No. 1, (Presented at Operations Research Society of America Meeting, 22 May 1954) AD 720 409

This study presents several mathematical models of assault operations in which a superior force of attackers attempts to land on an unfriendly beachhead. These simplified models may be used

M 1008 — Continued

in problems associated with the length of battle and the number of attacker casualties. The assault on Iwo Jima is examined to show how the length of battle and the attacker casualties might have varied with changes in the sizes of the initial forces and the replacement rates of the two opponents.

M 1009

Noah, Joseph W., "Cost Analysis in the Center for Naval Analyses," 6 pp. 19 Mar 1965, (Published as (CNA)43-65) AD 616 359

This document reports the plans and activities of the cost analysts within the Center for Naval Analyses. It is intended to inform and draw comments from interested Naval officers associated with the Center for Naval Analyses, from the management and project leaders in CNA, and from those outside of CNA engaged in similar activities.

M 1010

Sinal, Fred R. (RD3, USN), "A Global Inverse Function Theorem," 11 pp., Apr 1971

This paper applies the methods of algebraic topology to the analytic problem of existence of an inverse function. Given a continuously differentiable function on subset of real n-space, the existence of an inverse on the whole set is reduced to some conditions on the behavior at the boundary. While not necessary, these conditions hold in a wide variety of cases.

M 1011

"Annual Report of the Board of Overseers of the Center for Naval Analyses," (CNA Report (CNA)323-71 for the period ending 31 Aug 1971, and CNA Report (CNA)1792-72 for the period ending 31 Aug 1972, (CNA)1646-73 for the period ending Aug 1973, and (CNA)568-75 for the period ending Aug 1974) AD 739 380

This report is issued by the CNA Board of Overseers to executives of the Departments of Defense and Navy who are responsible for the contractual relationship between the University of Rochester and the Navy. CNA is charged with conducting a continuing program of research, studies, and investigations that will assist Navy officials in making policy decisions and with providing the Department of the Navy with operational capabilities. It also contains the management's annual review of work accomplished by CNA during FY 71 and a review of the Center's organization structure, the use of government resources, and the plans and programs proposed for FY 72.

M 1012

Herrick, Robert W., "Gorshkov Makes the Case for Further Great Expansion of Soviet Navy: A Current Series of Articles in Morskoi Sbornik by Fleet Admiral Sergey Gorshkov Commander in Chief, Soviet Navy," 74 pp., Oct 1972, (CNA Publication (CNA)1561-72, 19 Oct 1972)

This paper contains preliminary analysis on a series of articles written for Morskoi Sbornick (Naval Digest) by Fleet Admiral Sergey Gorshkov, Commander in Chief of the Soviet Navy. It points out that while Gorshkov's professed aim is to foster unity within the Soviet Navy as to its proper role under existing circumstances, his real objective is to justify a vast naval construction program. Using historical examples to convey proper role in the defense of the Soviet Union, Gorshkov interprets every occurrence in both Tsarist and Soviet Russian history to demonstrate that the USSR has an urgent need to get about building the much larger navy he holds as necessary for defense against the Western States and furtherance of the USSR's expanding maritime interests. This analysis proceeds on the assumption that Gorshkov's interest is not that of an historian and that he is not interested in writing an objective naval history, but that he is concerned with the further development of the Soviet Navy and is using military policy and strategy.

M 1013

Hibbs, Norma J., "An Introduction to the NARM," 10 pp., 1972, (Published as (CNA)1684-72)

This view of the Navy Resource Model (NARM) is intended for the reader who is not already familiar with the NARM and wants to gain a general understanding of how it works. Since 1969 the services have been required to develop their preferred programs within a fiscal constraint set by the Secretary of Defense. Today's Navy planner chooses force levels, major procurement programs, and ship and aircraft operating policies; constrained by the fixed budget, he achieves increases in one area only by giving up resources in another. It became desirable to have an automated technique that would rapidly and consistently determine the resources needed for the many broad choices open to Navy decision makers within fiscal guidance. The Center for Naval Analyses developed the Navy Resource Model (NARM) for this purpose. Given data that describes a base year, and a force structure of ships and aircraft that is desired in future years, it will develop a consistent program for those years.

M 1014

Anger, Thomas E., "A Critical Review of Defense Resource Planning and the Role of Analysis," 32 pp., Mar 1973, (Published as (CNA)864-73)

This paper discusses the resource planning involved in the preparation of the annual defense budgets, and the role analysis plays in this process. Chapter 2 deals with the process by which decisions about the size and allocation of the defense budget are made. Chapter 3 discusses in more detail the contribution of analysis to the decision process, and the limitations on what analysis can contribute. Chapter 4 summarizes the lessons that decision makers and analysts should remember about the decision process and the role of analysis. It concludes with suggestions on ways to improve the decision process that would change current practices without requiring fundamental changes.

M 1015

Herrick, Robert W., McConnell, James M., and McGwire, Michael K.,* "Admiral Gorshkov on the Soviet Navy in War and Peace," 1973, (The Gorshkov Series of articles were published in Morskoj Sbornik between Feb 1972 and Feb 1973, Issue Nos. 2-6, 8-12 for 1972; 2 for 1973; Published as (CNA)651-73.10, 968-73, 1303-73.30 and 100-74; see also CRC 257)

In February 1972 the Soviet Navy's monthly journal, the *Naval Digest,* began the publication of a series of 11 articles by Admiral of the Fleet Sergey Gorshkov, Commander in Chief of the Soviet Navy. The general title of the series was "Navies in War and Peace." The series of three working papers is devoted largely to a summary presentation and an analysis of the rationale presented by Gorshkov for building an even larger Soviet Navy.

Centre for Foreign Policy Studies, Dalhousie University, Canada.

M 1017

"Systems Evaluation Group Study Program," 22 pp., Feb 1974 (Published as (SEG)656-72.10)

This document provides a listing of major studies currently undertaken or previously accomplished by the Systems Evaluation Group (SEG) of the Center for Naval Analyses.

M 1018

Dismukes, N. Bradford, "Wartime Missions of the Soviet General Purpose Force Navy," 19 pp., Sep 1973, (Published as (CNA)1717-73)

This paper deals with conjectured changes in the wartime missions of Soviet "General Purpose" naval forces as the Soviet naval leadership adjusts the roles of its existing and planned naval systems to meet changing strategic and technical realities. It examines briefly the character of the changing strategic and technical realities. It examines briefly the character of the changing strategic setting; hypothesizes several possible Soviet responses; and concludes with a brief review of several implications for Western planners which appear to follow from the analysis.

M 1019

O'Neill, David M. and Stephan, Robert A. (Cdr., USN), "The New High Cost of Military Manpower," 18 pp., May 1972, (Published as (INS)57-72)

The significance of the All-Volunteer Armed Forces (AVAF) pay raises is much broader than merely attracting more people to voluntarily enlist in the military services. This paper addresses the problem of finding ways to compensate for the increased cost of manpower through increased productivity and more months of on-the-job effectiveness per accession. The discussion is divided into four sections: Civilianization, Capital/labor substitution, Procurement Alternatives, and Reduction of non-effective time. It is to be emphasized that our efforts are directed toward making people aware of the broad issues involved and pointing out areas for more detailed study rather than advocating one or another specific action to be taken.

M 1020

Tyson, James K., "Application of ASW Campaign Estimation Procedures to the World War II Battle of the Atlantic," 14 pp., Nov 1972, (Published as (CNA)1754-72)

A simplified analytical method is used to "predict" merchant ship and U-boat losses for two time periods of the Battle of the Atlantic. Prediction for the first 18 months of the war beginning in September 1939, is based on World War I experience. For the second 18-month period, beginning at U.S. entry into the war, the previous campaign is used as a basis. The predicted total losses agree fairly well with the historical results, but begin to break down, when extended beyond 12-18 months, as changes in weapon systems and training become effective.

M 1021

Anger, Thomas E. and Kanter, Herschel E., "Navy Responses to Changes in the Defense Resource Planning Process," 24 pp., Mar 1973, (Published as (CNA)644-73)

This paper begins with a review of the McNamara system, shows how the Laird system works and how it differs from the McNamara system, and ends with a discussion of changes in the Navy's planning process.

M 1022

Kent, Clement F., "A Maximization Problem," 13 pp., Jun 1962 (Published as Memorandum (OEG)705-62)

The following mathematical problem has arisen in the context of economics, but is sufficiently interesting to be stated as an independent mathematical problem.

The Problem: Given the following pair of equations

$$\sum_1^n x_i = 1 \qquad (1)$$

$$\sum_1^n x_i^2 = H^2 \qquad (2)$$

consider solutions $x_1, x_2, \ldots x_n$, where x_i are non-negative real numbers.

M 1023

Kelly, Anne M., "Briefing on Soviet Port Visits and the Internationalist Mission of the Soviet Navy," 33 pp., 6 Jan 1975 (Published as Memorandum (CNA)19-75)

This briefing discusses port visits, their use and effectiveness as instruments of Soviet Foreign Policy.

M 1024

Shulsky, Abram N., "Gorshkov on Naval Arms Limitations: *KTO KOGO?*" 20 pp., Jan 1974 (Published as Memorandum (CNA)2005-74.10)

In his series "Navies in War and Peace," Admiral of the Fleet of the Soviet Union S. G. Gorshkov presents a generally pessimistic view of the naval arms limitation agreements of the period between the two world wars. He notes that they did not achieve their stated purpose of naval arms limitation, and that "from the mid-1930's, a new unrestrained and in no way regulated naval arms race began." He borders on sarcasm in his description of the successive naval conferences as "the war of the diplomats for supremacy at sea."

M 1025

Borgstrom, Robert E. (USN), Goudreau, Kenneth A., and Kuzmack, Richard A., "Installations Planning," 250 pp., 1 Jul 1971, with appendices A, B, C, and D (Published as Memorandum (CNA)152-71.10, (CNA)153-71, and (CNA)154-71.10)

This paper responds to a request from the Secretary of Defense to conduct a selected analysis of Installations Planning. The analysis describes the Navy's entire shore/support structure in FY-70. Each base complex worldwide is described by a list of all the shore/support units (UIC's) at the complex and the personnel, TOA and NIF revenues of each unit. These data are summarized by fiscal guidance category and by claimant. The complexes are ranked according to size to determine how much of all shore/support is concentrated at a relatively few complexes. They are also sorted by major geographical area to determine the distribution of Navy shore/support throughout the world. The analysis also estimates FY-72 and FY-73 shore/support by complex by projecting the FY-70 data. These projections are consistent with the fiscal guidance category totals of POM-73. A regression analysis is performed to relate the amount of "base operations support" resources used in FY-70 to the numbers and types of units supported. Preliminary results are presented in this paper.

K. PUBLIC RESEARCH INSTITUTE

Studies

PRI 73-1

Brown, Jr., George F. and Silverman, Lester P., "The Retail Price of Heroin: Estimation and Applications," 68 pp., 16 Mar 1973

Develops estimates of the retail price of heroin in a number of U.S. cities and applies these estimates in analyses of problems associated with the use of illicit narcotics. Applications of the estimated price series provide insight into the structure of the heroin market and the relationship between heroin prices and crime.

PRI 73-2

Jacobson, Louis S., "The Use of Longitudinal Data to Assess the Impact of Manpower Training on Earnings," 39 pp., Jul 1973

Discusses research using Social Security data to measure the effect of government manpower training programs on the earnings of participants. Previous studies employed a longitudinal set of Social Security summary earnings records of over 50,000 individuals who participated in MDTA institutional training in 1964 and 70,000 individuals randomly selected from the same file. This study uses Social Security's Continuous Work History Sample (CWHS) to demonstrate that these prior studies have substantially underestimated the impact of training on earnings.

PRI 73-3

Silverman, Lester P., "The Determinants of Daily Emergency Admissions to Hospitals," 22 pp., Jul 1973

Studies of the demand for hospital services have generally ignored the determinants of arrivals of different types of patients in a geographic area. Requests for emergency admission are the most uncertain factor in the daily resource allocation decisions of the hospital. Emergencies constitute 30 percent of hospital admissions, but at least one large Pittsburgh hospital does not explicitly plan for them. This policy may be quite costly, both to the hospital and to elective patients in the queue. This paper investigates several distributed lag models for explaining daily emergency admissions (both total and disease-, age-, and sex-specific) on a county-wide basis. It is estimated that pollution and temperature affect admissions in susceptible disease classes; a 50 percent abatement in pollution would keep 1-2 respiratory patients out of the hospital each day. Day-of-the-week effects are surprisingly important for this class of patients.

PRI 74-1

Holen, Arlene and Horowitz, Stanley, A., "The Effect of Unemployment Insurance and Eligibility Enforcement on Unemployment," 30 pp., Apr 1974 (Published in Journal of Law and Economics, Oct 1974)

In order to produce a more reliable and more useful estimate of the impact of Unemployment Insurance benefit liberality on the measured rate of unemployment, an improved model of the structure of the UI system and the way it influences unemployment rates has been developed. The first section of this paper describes important legal and administrative characteristics of state systems, particularly the rules determining an applicant's eligibility to draw benefits and the opportunities for flexibility in administration of the rules. The second section describes our overall model of the UI system and presents results that show the relation between benefit liberality and unemployment.

PRI 74-2

Fraser, David W.,* Mitchell, James E.,** Silverman, Lester P., and Feldman, Roger A.,* Undiagnosed Bacterial Meningitis in Vermont Children," 9 pp., Oct 1974

Community-acquired bacterial meningitis in Vermont children under 5 years of age was recognized less frequently in 1967-1970 in those towns with low total hospitalization rates than in towns with hospitalization rates above 15 admissions per 100 population. Using the towns with high hospitalization rates as a norm, it was found that towns with fewer recognized meningitis cases than expected had significantly greater rates of death from obscure causes in children 1-59 months of age in 1967-1970. It is suggested that about 17 deaths in 1967-1970 in Vermont children 1-59 months of age were associated with the failure to recognize bacterial meningitis in children from towns with low rates of medical care utilization.

*Center for Disease Control, U.S. Public Health Service.
**Vermont State Department of Health.

PRI 75-1

Levine, Daniel, Silverman, Lester P., and Spruill, Nancy, "Urban Crime and Heroin Availability," 42 pp., Apr 1975

This paper reports the relationship between the level of crime and the price of heroin in Detroit, Michigan. In particular, we wish to estimate,

75-1 — Continued

using past data, how much of an increase in crime is associated with, say, a 10 percent rise in the price of heroin. Although such *changes* in crime can be ascribed to addicts alone by making the plausible assumption that non-addict criminals are unaffected by changes in the price of heroin, this study provides no information whatever on the question of what proportion of the current crime level is caused by addicts.

PRI 75-3

Shulsky, Abram N., "Abolishing the District of Columbia Motorcycle Squad," 18 pp., Apr 1975

This paper reviews the evidence concerning the abolition of the District of Columbia motorcycle squad and, from it, draws inferences about the process of terminating any government activity. Three questions are examined: What kind of problems arise to inhibit changes? How are the problems handled? What role does analysis play in the process?

PRI 75-4

Levine, Daniel B., Spruill, Nancy, and Stoloff, Peter H., "Public Drug Treatment and Addict Crime," 48 pp., Oct 1975

This study, intended to help in the evaluation of treatment policy, shows that public drug treatment in the city of Detroit has led over a recent 4-year period to the desired reduction in property crime. In reaching this finding, however, the problems associated with self-reported crime and limited sampling have been avoided by relating the monthly enrollment in all Detroit treatment agencies to monthly changes in the total level of property crime reported to the Detroit police.

PRI 75-5

Brechling, Frank, "Unemployment Insurance Taxes and Labor Turnover: Summary of Theoretical Findings," 19 pp., Dec 1975

In the United States, as apparently in no other country, income replacement payments to unemployed workers (as distinct from general income transfers to the needy) are financed almost exclusively by a tax on individual firms. Because of the complex legal provisions according to which the firms' tax bills are computed, the tax tends to have short-run and possibly even long-run incentive effects on the behavior of individual firms. For a full evaluation of the working of the tax and for an assessment of the effects of possible changes in the tax structure, it seems highly desirable that such incentive effects be ascertained in as much detail as possible. This paper summarizes the findings of an extensive theoretical study designed to discover the incentive effects on individual firms of the unemployment insurance tax as it is currently operated in most states. This research has yielded, first, some interesting and relevant insights which have important implications for economic policy and, second, a number of testable propositions which will be analyzed empirically in the near future.

Reports

PRI 40-74

Ehrenberg, Ronald,* Holen, Arlene, Jacobson, Louis S., Jehn, Christopher, and Katz, Arnold, "Summary of Statements and Remarks at the Conference on Study of the Unemployment Insurance System, Arlington, Virginia, January 25, 1974," 22 pp., Apr 1974

The purpose of the conference was to solicit advice from researchers outside PRI about how research on three major issues should proceed. The issues are: what is the effect of variation on the liberality of UI benefits in the job search behavior of workers; what is the effect of variation in UI taxes on the demand for labor; and what is the contribution of ES placement services to labor exchange efficiency.

University of Massachusetts.

PRI 112-74

Horowitz, Stanley and Holen, Arlene, "Unemployment Insurance and Eligibility Enforcement," 9 pp., Dec 1974

Summary of PRI Study 74-1 of April 1974.

PRI 130-75

O'Neill, David M., Classen, Kathleen P. and Holen, Arlene, "Effects of the 1974 UI Extensions on Unemployment," 20 pp., Dec 1974

In this analysis the effects that are likely to flow from two new laws extending Unemployment Insurance enacted in December 1974 are described, and the resulting change in the unemployment rate is estimated.

PRI 184-75

Jehn, Christopher, "An Evaluation of Proposed Alternatives for Increasing UI Tax Revenues," 8 pp., May 1975

The Unemployment Insurance tax system and

PRI 184-75 — Continued

the available financing alternatives are described. Briefly, the principle arguments currently being offered in support and opposition to these alternatives are summarized and evaluated. The economic implications of the several financing techniques are then analyzed.

PRI 186-75

Classen, Kathleen, "The Effects of Unemployment Insurance on the Duration of Unemployment and Job Search," 10 pp., Jun 1975

This paper discusses the questions: Is an increase in the weekly benefit amount associated with an increase in the duration of unemployment? And if so, is this increase in unemployment caused by an increase in productive job search.

PRI 196-75

Friedheim, Robert L. and Kildow, Judith T.,* "Report of the Ocean Policy Research Workshop," 49 pp., Feb 1975

In February 1975, a group of scholars, analysts, and U.S. Government officials with interests in or responsibilities for ocean policy were asked to attend a workshop sponsored by the RANN (Research Applied to National Needs) Directorate, Office of Exploratory Research and Problem Assessment, National Science Foundation, and managed by the Public Research Institute of the Center for Naval Analyses. The purposes of the workshop were to (1) assess "the state of the art" in research relating to ocean policy, especially that research which deals with international and transnational problems arising out of transformations of ocean scientific and technological knowledge; (2) determine the degree of consensus about the status of ocean policy among knowledgeable observers; and (3) propose to RANN/ NSF a research agenda and appropriate methods for carrying out that research which would allow the United States to create an ocean policy based upon facts, knowledge of available options, and an understanding of the process of their own and others' decision-making.

Department of Ocean Engineering, Massachusetts Institute of Technology.

PRI 197-75

Jacobson, Louis S., "Earning Losses of Workers Displaced from the Steel Industry by Imports of Steel," 15 pp., Aug 75

This paper presents estimates of the earnings that steel workers would lose if they were displaced from jobs in the industry by removal of import restrictions on steel.

PRI 199-75

Jacobson, Louis S., "Alternative Data Sources for Analysis of Unemployment Insurance," 11 pp., Jul 1975

This paper discusses the efficiency of two methods of collecting individual data for use in studying the unemployment insurance system: use of existing administrative records, such as the Continuous Wage and Benefit History (CWBH), is compared to a proposed special purpose survey similar to the National Longitudinal Survey (NLS) conducted by Herbert Parnes.

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